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GEMINIS PAPELES DE SALUD

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“...the principle of relativism, the relativity of our knowledge, a principle which, in a period of breakdown of the old theories, is taking a firm hold upon the physicists, and which, *if the latter are ignorant of dialectics*, is bound to lead to idealism.”

[Lenin, Materialism and Empirio-criticism.]

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The aim of Marxism, right from its very birth, has never been the attainment of simply a philosophical perception and explanation of the existing world. It has rather been, on the basis of scientific explanation, in practice to change and upset existing relations, for the motive force of history is not the abstract criticism of ideas but revolutionary practice.

V. I. Lenin has given a profound, many-sided, concretely historical definition of Marxism, as containing" a new outlook, consistent materialism which also covers the sphere of social life, dialectic as the most many-sided and profoundest teaching on development, the theory of the class struggle and the worldhistorical revolutionary role of the proletariat, the creator of the new, communist society". 1) The historical and logical essence of this new world outlook and its method (i.e. Leninism-Marxism of the epoch of imperialism and the proletarian revolution) lies in the unity of theory and practice," for only thus can a really proletarian party armed with a revolutionary theory be created". 2)

What is the connection between this practical, thoroughly revolutionary teaching, aimed at changing the world, and natural science, the science of those laws of nature which lie behind the practical activity of man when he puts the forces of nature to his own service?

The epoch in which Marx's system of views and teaching was formed was remarkable for its colossal achievements in the natural sciences and the growing social (class) function of natural science at that time.

The basis of this development of the sciences of nature was the path of conquest entered on by capitalism after the Vienna Congress of 1815. Industrial development and economic revolution gripped the whole continent. In the middle of the nineteenth century even Germany from" a mouldy philistine country" was transformed into a country with a developed industry and came into the arena of world trade.

The growth of productive forces gave a powerful impulse to the progress of natural science in all its departments.

Let us recall how, in the small space of time between 1830 and 1848, the law of the conservation and transformation of energy was formed and given its basis in the works of Joule, Mayer, Colding, and Helmholtz. At the same time Faraday discovered electro-magnetic induction. Organic chemistry developed, thanks to the work of Liebig and Wohler. In morphology Schwann's cellular theory was confirmed. In physiology we had the work of Johannes Muller and his school. In geology Lyell established the idea of evolution. Natural science passed through a period of the greatest ferment. Capitalism gave it birth and science in its turn thrust itself into the practical activity of the bourgeoisie and gave it new possibilities of industrial development. The classics of plant physiology and agro-chemistry, Senebrer, Sossior, Davy, Bassengo, Liebig, laid the theoretical foundation for rational agriculture. Thanks to the development of organic chemistry, from about the middle of the 'fifties there began a revolution in the chemistry of dyes which led to big changes in the textile industry. Pasteur, stimulated by the demands of production, made discoveries which in turn
influenced both agriculture and medicine.

So long ago as the 'forties a consciousness of the importance of the social function of the natural sciences made its way into the minds of scientific workers and public persons. A discussion took place among men of science on the connection between theory and practice, science and industry. We can point to J. Liebig as to the poet of the idea of the unity of theory and practice and the adversary of the theory of "pure science".

Alexander Humboldt in the 'forties gave a verbal foundation to the development of scientific knowledge, starting from" the different degrees of pleasure induced by contemplation of nature". But this indeed is merely an "ideological aberration" which he himself exposes by recognising the importance of the mathematical and physical sciences for the welfare of states. By his whole practical activity he rejects the theory of "contemplative bourgeois science".

The fact of the development of the teaching of Marx and Engels in this period of the Sturm and Drang of the natural sciences, when the achievements of science had been vastly enlarged and its social significance had grown, calls for an answer to a question of great importance for understanding the essence of Marxism

What is the relationship between Marx's ideas and natural science considered in its historical development ?

Were the theoretical roots of Marxism formed also in the soil of the natural sciences, or, on the contrary, is Marxism only a conception of history, a "science of the spirit", with which the science of nature has no inner connection ?

It is well known that it is just this latter view which is typical of the pseudo-Marxists (K. Kautsky, Max Adler, etc.). Karl Kautsky, the patriarch of the renegades, even in the years of his former "greatness" answered the question of what is meant by Marxism as follows: "I do not understand by Marxism a philosophy, but an experimental science, a special conception of society." Philosophy, the theory of knowledge, is a fine thing, "but one which has no more relation to the tasks of our Party than, for example, the vexed question of Lamarckism and Darwinism, or the question as to whether or not the atomic theory is sound". 3) Kautsky here advances a number of arguments. Marxism is nothing but a special "conception" of society, Marxism has no relation to philosophy, philosophy has no relation to party policy, and, finally, natural science has no relation either to Marxism, or to the policy and philosophy of the party.

Marxism is distorted in many ways in these arguments. If we turn to the last statement, then even a cursory attempt at explaining the role of natural science in the formation of Marx's ideas and the general relationship between Marxism and the natural sciences, will once more show convincingly how the pseudo-Marxists castrate the rich content of Marx's ideas, distort and contract their foundations, and so ideologically disarm the proletariat in its fight for communism.

From Engels' works alone it would be possible to show the inner relationship of the different consistent parts of Marxism to the science of nature. The Dialectic of Nature is the most allembracing attempt at applying the method and outlook of Marx to the data of natural science. It is an attempt which is as far ahead of all that was done in this sphere by German natural philosophy and by Hegel, as the condition of productive forces and natural science in the nineteenth century surpasses the century of the French Revolution.

We shall now endeavour to analyse the problems posed here by using Marx's work and starting from his activity in the sphere which interests us.

Of course, a "vast part of the main and leading ideas in the realms of history and economics in particular" belong to Marx. But it does not follow from these words of Engels that Marx took no interest in natural science, was not equal to the development of natural science in this age, did not bring the data of this realm of knowledge within the orbit of his system of views. To-day this aspect
of Marx's biography has been to some degree cleared up from the point of view of fact. He was interested in natural science while still a schoolboy, in the gymnasium at Trier, where he studied under the then famous geologist Steininger. It was the same in Berlin University where he followed the lectures in anthropology given by Heinrich Steffens, the follower of Schelling and a natural philosopher who was also an important geologist and mineralogist. Marx retained his interest in natural science to his last days. This interest manifested itself in him at various stages, in dependence on the time at his disposal for this kind of work, and in varying degree, either in acquaintance with, or study of, or active research into some scientific problem.

Marx's independent researches in higher mathematics are well known. In astronomy Marx studied Kirkwood, who discovered "a kind of law of difference in the revolutions of the planets". Marx studied the relation of this law to Laplace's hypothesis and connects this discovery with the Hegelian criticism of Kepler and Newton.

In this sphere of physics Marx read Grove's *The Correlation of Physical Forces*, the work of "the most philosophical naturalist" among the English and German scientific investigators. Marx followed Tyndal's work, paying special attention to Tyndal's splitting of the sun's rays into heat rays and rays without heat.

In chemistry, particularly in agronomical chemistry, Marx had fundamental knowledge. For many years he read the literature of this subject and studied Liebig, Schönbein and others.

In biology Marx read Schleiden and Schwarn, studied Darwin critically, besides Kelliher, Trémaux, Huxley, Fraase, Helmholtz, Traube and others.

We will not here stop to examine Marx's special study of historical and experimental technology, nor dwell on the keen interest Marx showed in the conquests of applied chemistry, like the economically profitable method of obtaining oxygen invented by Rebours, or on his interest in the achievements of applied physics, such as Deprez' experiment at the Munich electrical exhibition. As for the history of science, he had a very wide knowledge, as all his works irrefutably bear witness. Is there any basis after this for speaking of the indifference or carelessness of Marx in regard to natural science? The great thinkers who stood at history's turning-points, Bacon, Descartes, Spinoza, Kant, Hegel, generalised from the level of knowledge reached in their period and had the more permanent value, the wider the practical and theoretical basis for their conclusions, the more vividly their point of view rose above their own time. This applies even more to Marx than to any of his predecessors. Only a pygmy born to grovel in the gutters of the empyrean can look with contempt upon a giant solely because he "feels" solid ground under his feet whilst his titan's head is hidden in the clouds.

What are the inner sources which nourished Marx's interest in both modern and historical natural science? What are the motives which determined this interest not as something external and accidental, not as simply a curiosity for knowledge, but as an inner necessity, so that this interest arose out of the actual general tasks of Marx's theoretical and practical activity?

The history of Marx's concern with scientific questions may be generally divided into two periods, up to 1850 and after 1850. The essential content of the first period of Marx's theoretical activity was the finding of a basis for the materialist outlook and especially for the materialist conception of history. In the course of his work during this period he was drawn to a consideration of the problems of natural science.

It is not difficult to follow the historical course of his thought in the works collected in the Holy Family and in the German Ideology. Here Marx already advances and solves quite differently from the philosophers who had preceded him the two chief questions, what is nature-the object of natural science, and what is natural science-the science of nature.

Marx criticises Hegel's formal, abstract, mystical conception of nature. If real nature is a natural-philosophical form of logical foundation, the reflection of the idea, then it is something lower than
the idea, nature is "an imperfect being". The natural sciences from this point of view are directly bound up with theology and teleology, and can have no real importance, since they study the expression of the real creator of reality-the idea. Marx showed that the basis of this mysticism was the divorcing of nature from the practical activity of man. According to Hegel philosophical thinking must combine the practical attitude to nature with the theoretical. But with Hegel the determining basis remains the course of thought, the idea, and not practical activity, So with Hegel the picture of nature is distorted and fixed in its separation from man.

As distinct from Hegel, Marx looked at nature in its development, in its unity with man. Man is himself a part of nature. Man is historical nature and nature is natural history. It might appear at first glance as though Marx in not yet using the category of man as a totality of social relations, completely shares the outlook of Feuerbach. In reality Marx here also, in the works collected in the Holy Family, had already grasped the specific link, industry, which made the foundation for new views both on nature and on its relationship to man, as well as on the specific environment which man makes for himself in the general limits of nature.

As is well known, Feuerbach also speaks of everything in nature being in a state of reciprocity, everything being relative and everything being necessary, and he sees the unity of man and nature. But with Feuerbach nature swallows man. Feuerbach does not see the historical character of the specific relationship between nature and man, the dialectic of freedom and necessity, of the absolute and relative within these relations. Feuerbach understands nature abstractly. "It follows that nature is everything, save supernatural. Feuerbach is striking, but not deep," Lenin remarks. When Marx forcibly emphasises that "industry is the real historical relationship" between nature and man, he is laying the foundation for those views which he afterwards developed with exceptional power and depth in the German Ideology.

We are interested in that part of these views which is related to the analysis of the reciprocity of nature and man, to the analysis of the very conception of "nature". Marx's basic thought is that nature, with the development of man and his practical activity, does not oppose man as something equal to itself and eternally unchanging. Nature develops, but after man's appearance its development is not completed abstractly outside the sphere of man and his activity, since man, whilst submitting to it, also vanquishes it. Nature is not an abstract reality with eternal "natural vocations", it is given man in historically concrete fashion through his practical activity.

This thought (or rather, these thoughts) of Marx relates to nature taken in connection with man's practical activity, industry. For example, in the Roman Campagna there are pastures and marshland where in the days of Augustus, "one could see continuous vineyards and the villas of the Roman capitalists". This conception of nature also relates to natural science.

Neither is man connected with an absolutely unchangeable nature in his theoretical relation to nature, in natural science, which "gets its aim as well as its material, only thanks to commerce and industry, thanks to the sensual activity of man". 4]

Natural science has to do with a relatively changeable nature; on the one hand, as a result of the industrial activity of many generations, on the other hand (as the further development of science has shown) as a result of man's action upon it through the medium of investigation of observed processes.

The essence of the processes of nature cannot be understood without taking man's practical activity into account, which depends on the condition of productive forces and social construction. Only by starting from the practice of social life (industry, classes, social conditions) can human nature be understood as a part of nature as a whole, not only in the sense that man's psychology and ideas show their class essence, but in the sense of taking account of those natural (biological) changes to which he is subjected, when, in the process of changing reality, he also changes himself.

The method established by Marx spells the doom of naturalism in all its variations which looks on human society and man as an ordinary "child" of nature: the socio-power school (Podolinsky,
Ostwald) ; the geo-political (Rutzel, G. E. Graf, etc.) ; every kind of bio-sociological school, starting with social-Darwinism, from Karl Kautsky's attempts to supplement Marx with a doctrine of the instincts as the starting-point for the analysis of social relationships, or the efforts of the Austro-Marxists to correct Marx by the teaching of Freud, explaining religion and culture by biological factors, right down to the philosophy of modern fascism (O. Spann) which tries to base itself on a biological theory of completeness and a doctrine of races in the organic world.

Marx breaks down all kinds of teaching on freedom of will by showing that social being determines social consciousness and in this way extends the objective method to the study of the most complex social phenomena.

In place of inconsistent, abstract, materialist monism (Spinoza, French eighteenth-century materialism, Feuerbach), Marx lays the firm foundations for a materialist monism which is not abstract, but concrete, dialectical, consistent, taking account of the specific nature of human society, of all the inner connections between nature and man in their historical development. Marx gives a method and an outlook in which the dialectic of nature and the dialectic of history are indissolubly connected together.

In Marx's views the historical primacy of nature is not in any way broken. Even before the triumph of evolutionist ideas Marx establishes the following premises: the theory of creation is destroyed, as is shown by the natural sciences (geognosis); nature develops, it is in process of becoming even before the appearance of man; the development of nature goes spontaneously, is immanent, self-generated; the organic world (and man) arose through generatio æquivoca; life has not always existed as Thomson, Helmholtz and other representatives of the "absurd doctrine" of panspermy uphold. It follows that Marx understands this generatio æquivoca not as being the conception and birth of higher organisms without the intermediary of seed and parents (the mediæval form of this doctrine of generatio æquivoca, spontanea aut primaria), but in the sense of self-movement, self-development, i.e. in the sense which is in accordance with the chemical theory of the origin of life and the evolutionary theory of the origin of man, established within a decade and a half by Darwin's theory.

In a deep internal connection with these new views of the object of the natural sciences, of nature, Marx develops an absolutely new outlook on the science of nature, on natural science.

Even in the works belonging to the Holy Family Marx analyses, with greater power and depth than any of his predecessors (Bacon, Spinoza, the French materialists and philosophers of the age of enlightenment), the cultural-historical and social significance of natural science. Marx reproaches the philosophers for not taking into account the role and importance of the natural sciences. Natural science is not an external factor of usefulness for man or a chance factor of enlightenment. It is internally bound up with the most essential form of human activity, with practice, with industry, with the development of labour.

Industry is a practical relationship of man to nature, natural science, a "theoretical relationship". Industry is the basic form of practice, natural science, the foundation of human science. Industry discloses the real powers of man, and natural science is such a "real power", "a potential of production". Marx establishes the empirical origin and practical function of natural science and apportions a very important social role to natural science.

It follows that the power of Marx's analysis, surpassing all that had hitherto been written on the importance of the natural sciences, is determined by the fact that Marx knew how to generalise with genius the objective data of the epoch. Marx did not invent theories but summed up the experience of history and modern life. He often refers to the "gifts of science" which Davy, Liebig and others made to humanity.

In the German Ideology Marx gives a materialist analysis of the motive forces of the progress of the natural sciences. "Pure" natural science is not a self-sufficient factor having its own history quite independent of society. Social practice has the primacy in relation to natural science, i.e. industry,
social conditions. Natural science gets from practice both its aims and the means for attaining them.

If Marx in his early works spoke of natural science as a "real power of man", then in the *German Ideology* natural science appears as a real power of the ruling class. By force of the division of labour prevailing in class society, natural science is cut away from the material process of production into an independent function, a "spiritual potential" of production. Being a factor of progress at a definite stage, this ever deepening divorce of science from industry at the same time represented the basis on which idealism penetrated the natural sciences. But the relation between science and material production is itself historical in character, being different in the age of simple co-operation, of manufacture and of large-scale industry.

Science was one of the conditions for the development of capitalism (for example, theoretical mechanics, perfected by Newton, were the condition for the development of the third period of private property since the Middle Ages, large-scale machine industry), but it is also one of the conditions for the transition to a higher social formation, to socialism and communism. Science, at a definite level of the development of material productive forces and of social development, is transformed from a condition of the enslavement of the working class into a condition for the emancipation of the proletariat and humanity as a whole.

The development of the natural sciences is not determined synonymously with the development of productive forces. If in the last resort technique and industry determine science, it nevertheless demands for its development corresponding social conditions which, in the shape of definite classes and political relations, can either assist or hold back the progress of science.

Finally, an extremely important condition of scientific progress is the theoretical premises which are provided by the work, both of all preceding generations and by that of contemporaries. Marxism consequently does not coincide with vulgar materialism in the sphere of the history of science.

On the other hand, the attempt to deduce science and its history from the social needs of this or that epoch which, in absolute opposition to Marx's views, are understood in a purely psychic sense and used as the primal starting-point in analysing the history of the natural sciences (Gustav Eckstein, Otto Bauer, Otto Genosen, etc.), is an utter distortion of and complete renunciation of Marxism. This completely relativist theory is based on the ideas of Mach and Avenarius and is only connected with the great ideas of Marx with the aim of mocking and deceiving the working class. 5)

What is the relation between the natural and social sciences with Marx?

Marx's views on this question were formed on the one hand in the struggle against abstract materialism and naturalism which dissolves society into nature, and, on the other hand in the struggle against the complete divorce of history from nature (Bauer, the forefather of the Freiburg school). The divorce of the science of nature from the science of man is only possible on the basis of opposing man as subject to the objects of nature, in principle. But for Marx the monist, man, as we have seen, though a specific part, is nevertheless a part of nature. Just as nature is the basis of man, so correspondingly natural science is the basis of providing ancillary laws for the study of social phenomena. With all their qualitative difference, the science of nature and the science of man are one, for they study a single material world. They are one according to the materialist method, through applying which to the study of human society Marx discovered his conception of history.

Applying this discovery to the history of science, Marx discovered the dialectic of the history of the natural sciences. Through his analysis of the meaning of science, its social function, the motive forces of its development, its class content and the prospects of its development, Marx laid the foundation of the dialectical materialist history of the science of nature and was the first to lift the history of science on to the level of a real science.

The second period of Marx's preoccupation with scientific questions after 1850 is characterised by the fact that Marx fixes his attention on more concrete problems than those which interested him in the first period.
The wealth and variety of the scientific interests in this period of Marx's work are to be explained by the fact that Marx, on the one hand, in his work on political economy and the method of dialectical materialism, was forced to turn to natural science as a secondary science, and on the other hand by the fact that the development of science at this time was going impetuously ahead.

The attraction of science into the circle of Marx's interests proceeds by different currents.

His study of agronomic chemistry was started by his work on the study of rent. Marx in this connection, as we saw above, studied Liebig, Schönbein and everything achieved in this sphere by French authors. He followed for a number of years the dispute between the supporters of mineral and nitrate fertilisers, the struggle between the physical and chemical schools in agriculture. He was interested in everything written against Liebig's theory of the exhaustion of the soil and was acquainted with all the latest facts on this question.

Marx developed an interest in chemistry in general through his work on the method of scientific research, the theory of knowledge and the logic of dialectical materialism. This interest is inspired through the working out of the method "which lies at the basis of the Marxist criticism of political economy".

From this point of view Marx follows the revolution in chemistry and gives particular attention to the molecular theory which is connected with the names of Gerard, Kekulé and Laurent.

Since the fundamental laws of dialectic have force in both science and history, Marx uses chemical data to confirm his methodological premises. The law of the transformation of quantity into quality which Marx examines in the transformation of the craftsman into the capitalist, he simultaneously confirms by the fact that this law is valid in natural science and in chemistry in particular, where in homological series a simple quantitative addition of elements leads to the formation of qualitatively different bodies.

It is therefore a great distortion of Marx's teaching to affirm that in the natural sciences he was a mechanistic materialist. But it is just to this that Plekhanov's attribution of Feuerbachism to Marx inevitably leads. Franz Mehring completely agreed with Plekhanov when he wrote: "Marx and Engels always remained on the philosophical viewpoint of Feuerbach, however much they may have enlarged and deepened it by extending Marxism into the sphere of history. To speak briefly and clearly, in the realm of science they were mechanistic materialists, while in the realm of history they were historical materialists." 6)

Both historically and logically this is a very revealing distortion of Marx from the best representatives of the theoreticians of the Second International.

This distortion shows, as V. I. Lenin pointed out, a neglect of the very essence of Marxism by the theoreticians of the Second International, a neglect of materialist dialectic; it shows a lack of understanding of the fact that historical materialism is the result of applying to the study of history the very same method used by Marx in his study of nature. It shows a superficial understanding of the deep connection between the dialectic of history and the dialectic of nature in Marx and Engels.

For Marx science served as the basis for the working out of all aspects of his method and outlook. In connection with the logic and theory of knowledge of dialectical materialism, Marx followed attentively the philosophical evolution of such a great scientific investigator as Huxley. He attended Huxley's lectures, made himself acquainted with his written and spoken work, was interested in his attitude to Comteism and analysed Huxley's contradictory position, which approached materialism while still leaving agnostic gaps and attempting to compromise religion and science.

On the plane of philosophy and world outlook Marx was interested in the new works which showed that "the whole French school of physiologues and microscopists", led by Robin, had spoken against Pasteur, Huxley, etc., in favour of "generatio æquivoca". Marx in connection with the materialist conception of history follows science which represents the basis for his philosophical and historical views. From this aspect Marx welcomed the appearance of Darwin, whose teaching,
with all its deficiencies, gave a "natural-historical basis" to his own views. Darwin gives him a new and sharp weapon with which to criticise the teachings of Malthus which are closely connected with a number of economic and political questions.

The discussion of Darwin's work is deepened during Marx's lively discussion with Engels on the work of Trémaux. In this author Marx approves of, first, the effort to determine the Darwinian chance individual changes, since with Trémaux progress arises from necessity "on the basis of the periods of development of the globe", and secondly Trémaux's effort to give a natural historical basis to such social categories as nationality by advancing the idea of the influence of the soil.

As a politician and economist Marx followed attentively to see what new productive forces were evoked by the application of science to industry (Deprez in electricity, Rebours in chemistry, Bakewell in Zootechnics, etc.). For "science was for Marx an historically motive, revolutionary force". Marx saw the inner connection of science with the concrete tasks of the political struggle and showed how the data of science, which seem at first glance to stand apart, confirmed his outlook and proved the movement of humanity towards communism.

It is, of course, hard to follow in each separate instance the motives which urged Marx to occupy himself with this or that problem of natural science. In the realm of science it is only relatively possible to isolate separate aspects or plans of Marx's interests. In reality all these aspects are mutually connected and united. One and the same sphere of science might interest Marx in different relationships. The circle of the problems which he drew into the orbit of his theoretical activities was considerably wider than the one we have sketched. Marx worked in the mathematical sphere, he was on the level of development of modern astronomy, and so on.

It is impossible to minimise the circumstance that Marx stood on the shoulders of German natural philosophy. Like Engels, he did not reject it, but critically accepted everything of value it could give him. So that in this direction also he included in his outlook the whole past development of the natural sciences.

Finally, his close scientific friendship with Karl Schorlemmer had a great importance, and particularly the collaboration with Engels who specially interested himself in working out the dialectical method in the natural sciences.

But a deep necessity penetrated the apparently accidental character of Marx's scientific studies. This was his effort to create the most all-embracing system of views, to create a consistent teaching based on the widest generalisations of theoretical and practical knowledge, as a foundation for the political struggle of the proletariat.

It is here that there grow the roots of the necessity and inner purposefulness of Marx's scientific interests, which at first glance are apparently accidental and sporadically scattered.

Once upon a time professional men of learning in criticising Marx used to ask where in the works of Marx, "the historian and economist", his philosophy is explained, and especially his "philosophy of history"? The proper answer to this question has been given in its right place. Is there any foundation for asking this question in regard to the natural sciences? It may be said that we can find in Marx authentic statements on problems of the history of philosophy, that he has explained separate principles of the conception of nature, given an estimation of certain important scientific events of his day, but that he has no separate "philosophy of nature", that he lacks a complete Systema naturæ which answers all questions.

In such a form Marx certainly has no system of nature. Moreover, Marxism does not admit such a philosophy of nature since it puts the question of the philosophy of nature on a new basis of principle in comparison with the philosophy preceding Marxism.

Before Marx and Engels the nineteenth century had known two types of constructing a picture of the world, two types of approach to the establishment of a relationship between philosophy and science and in the very conception of the method of the natural sciences. The first type found its
most complete expression in Hegel's philosophy of nature. German natural philosophy and Hegel's philosophy had the aim of uniting "the collection of evidence on final objects", which was contemporary science, of uniting this evidence on a common basis, of showing its inner connections and representing nature not as a collection of scattered forces and matters, but as a complete and organised unity.

In view of Hegel's incorrect starting-point, in view of his idealism, the task he set himself could not be solved correctly.

Hegel's philosophy of nature necessarily dissolved into "rational science", for which the empirical sciences were only the condition, but not the main picture of the world. In Hegel nature is subordinated to logic, science only regulates the course of developing conceptions. In posing the problem of the connection between philosophy and science, in making a criticism of the narrowly inductive, analytical, descriptive science of the close of the eighteenth and the beginning of the nineteenth centuries, the natural philosophers (Treviranus, Ocken, Steffens, etc.) and Hegel played at that stage a positive part and had a fruitful influence on a number of important scientific investigators (Oersted, Schönbein, J. R. Mayer).

As experimental science developed further and the natural sciences were enriched by new data and were able to demonstrate factually the inner connections of nature, the method of the natural philosophers and of Hegel, which led to the abuse of deduction and the thrusting of artificial connections into nature, disclosed ever more clearly its own bankruptcy. After the period of the "illusory" connection of philosophy and the sciences of nature, science emancipated itself and drew apart from philosophical thinking.

The second type of constructing a picture of the world is characterised by the fact that it is applied on the basis of the empirical sciences alone, outside of all conscious connection with philosophy. Such is the vulgar materialism of Vogt and company, such is the "ordinary positivism" of Comte and of Alexander Humboldt's doctrine of the "Cosmos" which is in many ways akin to it. In dwelling for a moment on the "Cosmos" let us recall that in it the author set himself the aim of giving "a contemplation of the universe based on empiricism, on analysed thought, i.e. on the totality of phenomena collected by science and subjected to the laws of thought, comparing and putting together these data". 7)

This attempt of Alexander Humboldt had one positive side insofar as it expressed the necessity of comprehending the connection and unity of the data of the natural sciences, not at the dictation of an abstract idea but on the basis of actual empirical knowledge.

Owing to Humboldt's utter philosophical helplessness his "Cosmos" gave not a picture, but a mosaic of nature, not the inner connection of the data of science, but their external arrangement, not a system of knowledge, but an aggregate of observations. If Hegel's philosophy of nature was subjected to logic, then the "Cosmos" was divorced both from logic and philosophy (herein is its methodology) and hence arises its poverty in comparison with the Hegelian philosophy of nature.

If Hegel gave a method to the scientific investigator which nevertheless contained a grain of reason, Humboldt, on the other hand, disarmed the investigator into nature. The "Cosmos" was retrogressive in the philosophical sense compared with German classical philosophy, and disappeared without leaving any important traces in the history of science.

The dialectic of nature of Marx and Engels represents the overcoming of both the types of conception of the relations between philosophy and science outlined above, types of the construction of a philosophy of nature.

According to Marx's teaching it is impossible to compose a single conception of nature and get a method for investigating nature, by starting from the activity of pure reason, for which science appears only as the condition of its movement.

On the other hand the dialectic of nature is impossible on a bare foundation of science outside of
Materialist dialectic is the "total, the sum, the result of the history of the knowledge of the world". This method of investigation and understanding of objective reality in the full totality of its relations, in its development, transitions and inner contradictions, is the method which may be shortly described as "the doctrine of the unity of opposites" (Lenin).

The dialectical investigation of nature is a method of the investigation and understanding of nature. This conception of nature is founded on the application of materialist dialectic to the data of science as they are obtained at each given historical moment. The dialectical method brings no artificial connections into nature and does not solve problems by substituting itself for the natural sciences. It helps in critically understanding and connecting facts already obtained, it points out the paths of further investigation and fearlessly poses uninvestigated problems.

The dialectic of nature is inseparable from the dialectic of history with which it is connected by a unity of method, as two sides of a single teaching on a single, objective reality, as inseparable parts of the complete world outlook of Marx. This means that a real knowledge of nature and a conception of it as a developing whole is only possible with the knowledge of the laws and history of the development of human society which forms a specific part of nature. This means, further, that for the dialectical materialist science puts a stop to its pseudo-independent existence divorced from every aspect of social practice. The Marxian scientific investigator is consciously included in a single and inseparable complex of the theoretical and practical activity of a class which is the agent and motive force of historical progress. Science then finds its true ground and obtains a powerful impulse for its infinite development. It becomes a real weapon of struggle for changing the world and for the emancipation of the proletariat, and is transformed into a progressive and historically revolutionary force for the rapid construction of communist society.

The general foundations of the "philosophy of nature" in such a conception were laid by Marx and were systematically worked out by Engels on concrete material. Engels in this respect played a special part as one of the creators of the world outlook of the proletariat.

Marx's interest in science was not a manifestation of intellectual or scientific snobbery. The historical path of his theoretical activity has a deep logical foundation. Materialist dialectic, that most precious theoretical weapon of Marxism, could not be the general teaching on the laws of movement in nature, history and thought, unless it had been checked by the facts of science.

Dialectic as a theory of knowledge could not have been created without the generalisation of the rich experience of the history of natural science and the role of science in the knowledge of man. V. I. Lenin, that dialectician of genius, gave a special place to the history of the natural sciences (particularly to the history of the mental development of animals, the physiology of the sensual organs, etc.) in the series of other sciences "from which the theory of knowledge and dialectic must be formed". The materialist conception of history could not have been created but for the study of the laws of development of science which is a particularly important manifestation of the social superstructure. A study of the role of science is essential for the theory of scientific communism both as a condition for the emancipation of the proletariat and as a condition for the construction of communist society. Finally, the creation of political economy also calls for the study of natural science as a condition of technical and economic development, as an essential condition for the
functioning of the forces of production.

The great historical and revolutionary power of the teaching of Marx, Engels, Lenin and Stalin lies in the fact that it represents the sum of a colossal generalisation of all aspects of man's theoretical and practical activity, of the whole struggle of the working class. It is a united, complete, vital world outlook in which all the component parts are connected and bound together by indissolubly and incontradictably united principles.

This is precisely why it has managed to stand the test of the fire of revolution and the many-sided practice of socialist construction, both as a precious guide to action and as the theoretical foundation of the policy, strategy and tactics of the party.

The fifty years which have passed since Marx died fill an exceptional place in the history of science because of the rapid rate of progress in natural science.

Frederick Engels in his classical works discovered the inner meaning of the natural sciences in the nineteenth century, the materialist and spontaneously dialectic character of their content. So far as concerns the development of science in the last decade of the nineteenth and beginning of the twentieth century and the relations of science to Marx's ideas in the epoch of imperialism, V. I. Lenin answered this question. A whole number of bourgeois philosophers, scientists and theorising politicians have given a reactionary solution to the question of the relation of science in modern times to philosophy and world outlook. They declare that twentieth-century science has refuted the ideas of materialism which once prevailed and which go back to French materialism of the eighteenth century, and that it has brought with it a "regeneration of the human spirit" and the triumph of idealism. For two centuries the materialist outlook has been widespread, the important German biologist Oscar Hertwig wrote,

but unless all the signs of the times deceive us, we are now again at a decisive turning-point in the spiritual development of man. The two hundred years' reign of various materialist trends, against which from time to time in the past different distinguished writers have raised warning and prophetic voices, like Goethe, Fichte, Carlyle, Karl Ernst von Bar, like the physicists Fechner and Mach, is today again about to yield its place under the pressure of time to an idealist outlook.

This turning-point was announced almost simultaneously in the organic and non-organic sciences, but it was made particularly clear in modern physics.

V. I. Lenin has shown what were the conditions and causes which brought about this change and what was its true philosophical and class meaning. Twenty-five years have passed since Lenin gave his deep and all-round analysis of the crisis in science. In that time many new conquests have been made in physics, but the crisis has grown deeper yet, embracing fresh realms of science. The estimate made by Marx's great successor has not only remained unshaken but has received fresh confirmation.

In the same year as Engels died, the Württemberg professor V. K. Röntgen discovered rays which were created by the impact of electrical charges on objects in exhausted tubes. This discovery marks the beginning of dazzling successes. From 1895 to 1900 the teaching on radio-activity was created, Zeeman's effect was discovered, Planck put forward the quantum theory and thereby laid the foundations of modern physics. Rutherford established the nuclear theory of the atom and then the work of Niels Bohr began to develop the theory of atomic structure, and one after the other came a succession of pictures of the atom. In 1905 Einstein created a partial theory of relativity. In 1913 Moseley's work allowed us to penetrate further into the meaning of the connection between the elements and their arrangement in horizontal periods and vertical groups in Mendeleev's table. These works help us to understand the astonishing phenomenon of Aston's isotopes. Finally, in 1926 begins the development of wave mechanics. The impetuous movement along the path of new discoveries is not stopped, but physical thought penetrates the complex structure of the atomic nucleus. New methods of physical research lead to the reforming of the sciences near to physics, of astrophysics, chemistry, crystallography and geology.
These fresh facts and theories insistently demanded a fundamental change in all the firmly established conceptions of the old classical mechanics. Newton's mechanics were based on the conceptions of mass, energy, space and time as metaphysical substances existing separately and independently of one another. It turned out that they are interconnected and united. Mass depends to a great degree on speed. Space and time do not exist separately, they are not forms separated from their content, matter. Impenetrability, inertia, mass, have ceased to be the unchanging properties of matter. The continuity prevailing in nineteenth-century physics has proved an inadequate and one-sided category, since the quantum theory has shown the importance of interruption in nature. The conception of the atom as the final and indivisible brick in the world edifice has collapsed, just as has the established confidence in the immutability of the elements, etc.

Failing to get beyond the old method of research and to bring forward a more perfect form of thinking corresponding to the level of scientific development in place of the old outworn form, repelled by bourgeois social relations from dialectical materialism which alone is able to replace the mechanistic materialism formerly prevailing in science, and expressing the growth of reaction "all along, the line" which is characteristic of the epoch of imperialism, the bourgeois physicists have turned to idealism and all the varieties of reactionary philosophy.

In analysing the theoretical premises of the crisis in bourgeois science, V. I. Lenin pointed to the progress of mathematics and physics as the first cause giving birth to "physical" idealism; the second cause is "the principle of relativity, the relativity of science, a principle which, in a period of utter breakdown of old theories, imposes itself with especial force upon physicists and which, due to ignorance of dialectics, inevitably leads to idealism". 9)

This argument is confirmed with especial force by modern physics.

From the relativity of the measurements of time and space fixed by modern science, physicists draw a one-sided conclusion concerning the exceptional relativity of these categories. Metaphysical reason is accustomed to a conception of the atom as an unchanging unity of mechanical structures. It calls for a stable starting-point and a final cause. But, since the atom is capable of disintegration, since the research-worker has not yet, at our present level of knowledge, been able to establish the causes of the processes which take place in the atomic nucleus, the physicists therefore draw the conclusion that it is necessary to renounce the law of the conservation of matter and energy.

From the difficulties connected with the circumstance that actual research into inter-atomic phenomena brings about changes in the object observed, a doctrine has been formed that the measurement of physical quantities in microphysics is in principle inexact and that therefore their unknowability is confirmed. As though during biological experiments, no place is found for this change in the object, which has nevertheless not prevented the penetration of the secret of, say, cariokinesis, or of the working of the muscles in biochemistry. From this well-known fact of the change in an object under investigation the idealistic conclusion has been drawn that the object has no existence at all apart from the subject (N. Bohr, P. Jordan). From historically-conditioned difficulties of the methodology of physical research they draw the conclusion of "a theoretical limit" and fix absolute bounds of knowledge, as though the history of science has not completely refuted such a declaration of "Ignorabimus". The physicists, W. Heisenberg, P. Jordan, N. Bohr and others, demand a renunciation of the category of causality, though this renunciation, as Planck warns us, "is a serious thought owing to the consequences arising from it". "The new theory of knowledge", P. Jordan writes, "calls for the renunciation of all that mysticism of conceptions which was expressed as a faith in the 'compulsion', the 'necessity', in the 'comprehensibility' or the 'explainability' of natural laws and causal relationships." 10)

The physicists, save for a few insignificant representatives of the old generation, are turning back to Kant or even more to Hume. The Machists, Franck, Reichenbach, Schlick, are utilising these difficulties of modern physics, systematising them and giving a basis to the reactionary conclusions of the physicists and raising them to the heights of theory.
It does not come within the task of science, in the opinion of the majority of modern bourgeois physicists, to explain processes, but only to describe them, for from this point of view the research worker in general does not know objective reality and is compelled simply to describe statistical laws of behaviour.

These reactionary conclusions are strengthened by class interest and are utilised as an ideological weapon of struggle against the proletariat. For example, the theorising fascist, R. N. Coudenhove-Kalergi, strives in his struggle against Marxism to work from the reactionary tendencies in modern physics and biology.

The disintegration of the atom by Hertzian rays and wave mechanics, he declares, have brought victory to idealism. Materialism is refuted. Science, from which it worked, has turned against it. It has destroyed the idol which materialism wished to set up in the place of god, the idol of matter. "With the banner of a 'scientifically' justified idealism in his hands, with God and Nietzsche on his lips, he agitates for a crusade against the Bolsheviks, those solitary allies of materialism, for a crusade organised, of course, under the leadership of an 'all-saving personality'." 11

In fact, any conclusions in favour of idealism and fideism are not in accordance with the content of modern physics. When a physicist deflects a-rays by an electrical or magnetic field, when he establishes that one grammee of radium discharges $3,5 \times 10^{10}$ particles in a second, he has no doubts about the real and objective existence of rays and particles. The materialness of the world is not refuted either by the theory of relativity or by the fact that, close upon the molecule and the atom, the nucleus itself has turned out to be only a "relationship" of matter, nor by the other achievements of the modern physical sciences.

Modern physics actually confirms dialectical materialism. The theory of relativity is evidence of this in bringing us to a conception of the unity of mass and energy, of space and time. So also is the collapse of the conception of immutable qualities and elements. So also is wave mechanics which affirms the unity of interruption and continuity, etc.

Amazing as is the transformation of imponderable ether into ponderable matter, from the viewpoint of "common sense", and conversely, amazing as the absence of any other kind of mass in the electron save electromagnetic may appear to it, together with the strange discovery that mechanical laws of motion are limited to only one region of natural phenomena, while the others conform to subtler laws of electro-magnetics and so forth-yet all this for dialectical materialism is only another confirmation of its truth. 12

In the light of Marx's teaching the fact becomes comprehensible that, in the main, similar processes are observed in the development of both inorganic and organic sciences in the last decades. In this period in biology not only have the sciences formerly worked out been deepened, but new realms of knowledge have been discovered. To characterise the achievements of this period it is enough to recall the mechanics of development and experimental morphology, the theory of fermentations, the discovery of hormones in plants and animals, vitamins, the theory of tissue cultures and isolated organs, genetics, ecology, I. P. Pavlov's theory of conditioned reflexes, etc.

The new facts discovered in the spheres of morphology and physiology—the facts of regulation and restitution, established by the mechanics of development, the wholeness of the organism, regulated by the nervous system and inner secretions, the complexity of the processes of nourishment and motion in plants which are far from being reducible to simple laws of mechanics (the works of Max Nordhausen and Alfred Noll), etc., have called for the replacing of the insufficient, one-sided mechanical method. It was necessary to advance new principles for the connection of the growing heap of material. It was necessary to create a new "philosophy of the organic" on the basis of the factual data discovered.

In the period when capitalism had passed into the latest stage of its development, imperialism, in conditions of the growth of reaction among the bourgeoisie in its struggle against the working class and the colonial peoples, with the flourishing of reactionary trends in philosophy, science and art, the new data discovered by biology and eloquent of its factual progress, have brought about a crisis
of theoretical thinking in the sciences of the organic world.

A "new course" in biology has commenced along a path sown with metaphysical and psychological conceptions, entelechy, the dominant, impulse, the super-individual soul, morphastesia, autotropism, mnema, etc.

A wave of reaction is rising in biology and beginning to struggle against the main biological achievement of the nineteenth century, Darwinism.

"A salutary reaction against Darwin's speculations has begun," declares O. Hertwig. "It is necessary to exclude Darwin from the series of scientific theories . . . . Darwinism has perished ingloriously," declares the Kantian Jakob von Uexküll. Eminent biologists declare that, despite the development of science, "the gap between living and non-living nature, instead of gradually closing up, has rather become deeper and wider".  

In fighting onesidedly against mechanistic methods in biology they reach the conclusion that biology does not have a method of its own, since it is heterogeneous in its logical composition and in theory yields to physics and chemistry, just as in the laboratory the biologist is gradually giving way to the engineer. It is therefore necessary to create a biology as a science sui generis, for "real biology is almost destroyed".

The ground is being prepared for the proclamation of the coming of an epoch with a new world outlook born on the biological wave (Jakob von Uexküll), for the aggression of vitalism and the appearance of a number of organically founded reactionary philosophical systems (O. Spann-the philosopher of fascism, Henri Bergson, etc.).

Vitalism (neo-vitalism) is the inevitable shadow of mechanism and its necessary complement.

On the one hand the mechanists affirm that the living is a machine, though certainly an historically-developing, complex machine; the living is an object completely dependent on external environment, its passive shadow. On the other hand, there is the opposite declaration of the vitalists that life is an autonomous subject, the laws of life are "absolutely independent and self-acting vital factors, which have the primacy over all inorganic laws; these latter must submit to the former in opposition to what has been hitherto accepted".

On the one hand, we have a violent reduction of life to physics and chemistry and the establishment from below not only of the unity, but also of the identity of nature. On the other hand, is an impassable gap between the organic and inorganic worlds, or a universal teleology which establishes the idealistic identity of nature from below.

On the one hand, the mechanists state that the organism is only a sum of parts, on the other hand, the category of totality (Individuum, Totalität) is put forward, in relation to which the part is merely a subordinated means. On the one hand, causality understood one-sidedly (causa efficiens) as a renunciation of chance and expediency the reduction of consciousness to the role of epiphenomenon, a statically morphological approach to the study of organic phenomena. On the other hand, we have expediency on the basis of indeterminism (causa finalis), the introduction of psychological factors as the leading ones in the explanation of biological processes, and a one-sided physiologism, divorced from structure. The vitalists exaggerate, onesidedly expanding certain features in the fundamentals of biology, the facets and aspects of organic phenomena, just those features which the mechanist biologists are absolutely powerless to explain.

The numerous schools created out of the break-up of biology and which are attempting to solve the dilemma, "mechanism or vitalism", the representatives of "organic biology", the Machists (Hans Winterstein), the "positive" vitalists (L. von Bertalanffy), the mnemonics of E. Bleuler, etc., are rather the smitten than the smiters, since vitalism is invulnerable from the positions of idealism or eclecticism.

Whither, for example, does the mighty condemnation of vitalism pronounced by Ph. Franck lead us? Vitalism, he says, is only a negative concept. It is an expression of despair in physico-chemical
method. "Nowhere is there a really vitalist biology. You can construct nothing out of cries of despair." 16)

Actually his threats to vitalism are anything but terrible. In fact, as we know, science for a Machist is only the simplest description of phenomena—according to the principle of economy of thought. Science has to do with experiences and the symbols adapted to them. For Ph. Franck considers that the nucleus, protoplasm or reductive division, for example, are only relations between symbols. Why then not construct a biology as a science utilising the conception of "induction" borrowed from Uexküll or Driesch's superpersonal entelechy? Franck can say nothing at all convincing against such a possibility. Moreover, he has to recognise as theoretically possible the construction of biology out of teleological representations. The Machist cannot dispute that entelechy is a more economic symbol than the categories of scientific biology, but god or goblin is a simpler representation than Uexküll's "psychoidal law of induction" or Driesch's unrepresentable entelechy, to which we might apply Mephistopheles' words

With thought profound take care to span
What won't fit into the brain of man.

Trying to work from the most recent achievements in biology, vitalism tries thereby to prove that it is corroborated by the Conquests of science. But the reliance on Spemann, Jennings, Yerkes, etc., is purely verbal. The whole "philosophy of the organic" of the vitalists is reduced to the fact that the laws of the material world discovered and established by biology are connected in a purely verbal way with "psychoidal induction".

and entelechy. For example, Academician I. P. Pavlov's wellknown teaching which permits us by using a strictly scientific method to establish certain essential laws of the functioning of the higher nervous activity, and which is not only materialist but a teaching objectively confirming the laws of dialectic, is also, it appears, called on to confirm vitalism. "Pavlov's wellknown experiments", Uexküll writes, "are particularly fitted for the study of induction." 17) But the fact is, however, that this induction is anything but fitted for a weapon of biological research from the point of view of the teaching of Pavlov himself, since this induction is a metaphysically reversed and mystified conception of the reflex. Uexküll tells us concerning this mysterious induction that it is a "psychoidal law" and thus reveals that either he will not or cannot understand what are the reactionary tendencies in physiology against which Pavlov's teaching on conditioned reflexes is aimed.

Neo-vitalism seeks confirmation in the data of comparative physiology, particularly the physiology of the organs of the senses. With this comprehensible aim Johannes Müller's law of the specific energy of the sense organs is adapted in an absolutely one-sided fashion in the spirit of "physiological" idealism and raised to the rank of "the fundamentals of all biology". By bringing under it all the facts of modern physiology, including Pavlov's teaching, it is not hard to reach the conclusion of the autonomy of life and the primacy of vital factors.

These attempts by the vitalists to work-after Driesch's experiment in the sphere of the mechanics of development—from the facts of the physiology of the sense organs, show how true was Lenin's brilliant analysis which established the problem of relativism as the methodological core around which the crisis in bourgeois science revolves. In fact, for those who hold a metaphysical standpoint it is particularly difficult to grapple with the element of subjectivism and relativism which exists in the data of the sense organs. On the other hand, the data of the physiology of the sense organs which are eloquent of this relativism are the more attractive for those who strive to justify a "physiological" or any other form of idealism.

Lenin's analysis of the crisis of the physical sciences is fully applicable also to the explanation of the condition of modern biology. As in physics, the theoretical premises for reactionary inclinations were created by the very progress of biology. As in physics, in place of the mechanical method a deeper form of thinking was called for. A fundamental refashioning of the main categories of
biology was demanded, of life, the individual, causality, expediency, development, form, function, etc.

The majority of research workers in biology have also, under the pressure of the social conditions of the imperialist epoch, having no knowledge of dialectics, turned towards reactionary philosophy. This turn to reaction in theoretical biology has a different expression. The ranks of the supporters of mechanical materialism have grown thinner, whilst the theoretical biologists, resurrecting the anything but advanced aspects of the teaching of the great investigators of living nature, Lamarck, K. E. von Bar, Johannes Müller, appealing to the shades of Kant, Schelling, Ocken, Mach, etc., have created many schools of different idealist shades from Machism to Driesch's metaphysical vitalism. The condition of the bourgeois philosophy of biology is largely characterised by the style of ideas which Hans Driesch is rather actively propagating. His Schillerian "Hans metaphysicus, a famous thinker, a great little man" is preaching from the roof of the vitalist tower his philosophy of the organic constructed on the data of biology plus an inconceivable entelechy which after death is transformed into a superentelechy, as is demanded by "the doctrine of immortality in its Indian form, consequently, by the doctrine of the transmutation of souls". 18)

The crisis of modern biology is deepened still further by the fact that the crisis in the border sciences, in physics on the one hand and medicine on the other, influences biology, strengthens the chaos of conceptions and chokes it with incorrectly drawn conclusions even in the sphere from which they are transferred.

The representatives of physics have dealt a heavy blow at modern biology by attacking determinism and preaching freedom of will, which they deduce from the apparent indeterminism of infra-atomic processes (A. Sommerfeld, N. Bohr, P. Jordan, etc.).

Jordan, for example, openly considers it unreasonable, in view of the fact that we do not know the basis of the disintegration of the atom, "to ask the question of on what basis this mutation has taken place just at this time, and not thousands of years before". 19)

The reactionary views of the physicists have given direct support to the vitalists and upset the mechanists. In illustration of this argument it is sufficient to recall the name of Ludwig Rhumbler. This famous mechanistic biologist, who for many years has laboured to explain the most complicated biological phenomena as the playthings of physico-chemical forces under the control of natural selection, is now beginning to overestimate values and surrender to Hans Driesch. Taking the word of A. Sommerfeld for the fact that indeterminism is observable in the atomic system and a purposive foresight is shown by its particles, Rhumbler draws conclusions which he applies to biology. He admits that an entelechy capable of a mechanistic interpretation may be accepted. He is inclined to suppose that an entelechy is already given potentially within the atom in the shape of the energetic factor.

This slipping into the position of extreme vitalism, panvitalism, is particularly significant in a mechanist.

Just as in physics, so also in biology the latest achievements of science disclose the insufficiency and limitations of mechanical materialism, but they completely confirm dialectical materialism.

All the recent achievements of biology, the mechanics of development, the theories of ferments and vitamins, the facts of endocrinology, genetics, the theory of conditioned reflexes, etc., are a complete refutation of vitalism.

As a concrete illustration we will recall the events connected with the works of Spemann and his school.

These experiments established that the dorsal lip of the blastopore of an embryo of an amphibian when transplanted into the undifferentiated regions of other amphibia becomes possessed of the capacity of inducing a development of the nervous system, chords and mesoderms.

The nature of the action of the spheres of an embryo (Spemann's "organisational centres") was
unknown until recently. The vitalists, always ready to speculate on phenomena still unstudied, hastened to declare that "Spemann and his pupils have shown in recent years the amazing multiplicity of, cases of harmonic equipotentiality". 20)

So Spemann's organisers were to prove in this way the allpowerfulness of entelechy.

But the recent works of Holtfreter, who got induction by transferring "organisers" killed by heat, frozen and dried, and the analogical works of Bautzmann, O. Mangold and Wemeyer compel us to see a chemical basis for the phenomena of independent development.

Materialism has triumphed again. A crushing blow has once more been dealt at vitalism, which is not only "a lazy", to use Claude Bernard's expression, but also a deeply reactionary conception of modern biology.

The achievements of modern biology have brought triumph to materialism, because they explain the objective laws, the material bases, the conditions and causes of the morphological and physiological processes of a single, developing, organic world, because these achievements enlarge the theoretical basis of plant science, animal science and medicine, that is of the practical activity of man directed towards the mastery of the forces of nature.

It is precisely dialectical materialism which is confirmed by the achievements of modern biology. It is only materialist dialectic which gives a method of research, and it is the conception of unity of opposites which is the law of the processes of the organic world (assimilation and dissimilation, autonomy and correlation of organs, etc.). Materialist dialectic allows us to understand the element of relativity, the subtlety, the fluidity of the categories of biology (genus, species, individual, etc.).

Materialist dialectic is confirmed by the whole movement of biology as a science taken in its whole and compelling us to see the unity of the organic world in its inner connections and reciprocity. During the nineteenth century the two chief departments of biology, morphology and physiology, developed in deep separation from one another, to the mutual harm of both. The principal significance of the opening up of a new sphere in biology, experimental morphology, lay in the throwing of a bridge (as was seen by such a thoughtful biologist as K. A. Timiryazev) between these two completely separated spheres.

The further development of biology has still further narrowed the artificially created gap between the morphological and physiological sciences.

Endocrinology and its connected morphogenetics show the unity and reciprocity of form and function and compel an understanding of the unity and connection of the morphological and physiological sciences.

Lenin has shown that the content of dialectic must be checked by the history of science and not by separate examples.

The history of the development of biology during the last decades furnishes convincing proof of the depth of thought of this dialectician of genius.

Thus modern natural science confirms from all sides Marx's immortal ideas. Just as the inner meaning of the achievements of science confirms the materialist dialectic of nature, so the present condition of science and its social role confirms the correctness of the Marxian conception of history.

In the countries of capitalism, where once Kepler and Galileo, Descartes and Newton, laid the foundations of modern science, this science is to-day in a state of serious crisis, accompanied in certain parts by complete stagnation and sharp decline.

The external history of this crisis and its manifestations have been fairly well described by bourgeois savants who continually return to this painful theme.

The old ideas and conceptions are utterly destroyed in the physical and biological sciences. The
numerous tendencies created by the break-up of the old science attempt to advance new conceptions to unite the mass of facts discovered in the progress of science. But nothing but "chaos" (L, von Bertalanffy) and "confusion" (M. Planck) result from the search for a method.

The outlook of these scientists is distinguished by its reactionary character, its pessimism and direct connection with teleology.

The physicists, like Sir James Jeans, declare the universe is finite, and proceed to the conclusion of the existence of a mathematical creator of the universe.

The biologists support a general teleology (holism, emergent evolution). They speak of the inevitable degeneration of civilised man (D. Kotzowsky), of the mystery of the organic world (Charles Rickety, of the immortality of the soul (H. Driesch), etc. 21)

In place of rationalism we have intuition, in place of determinism, indeterminism, the mechanistic picture of the world has yielded to the organistic. Romanticism, mysticism, pessimism and fatalism, are growing. On the one hand, philosophical thought is going into a decline, since it is incapable of generalising accumulated material ; on the other hand, scientists are afraid of philosophy, "for philosophy is the opium of science". Positivism and Machism are growing, different schools are reviving the teaching of Berkeley, Hume, Schopenhauer and Schelling, and Nietzsche's "blond beast" is opposed to the mighty figure of Marx.

Max Planck, the physicist, denying the crisis in words, gives interesting indirect testimony of its existence. Planck indeed confirms the presence of a crisis when he is compelled, in retreating and yielding his positions, to defend the causality and objectivity of the physical world. He confirms the crisis in bourgeois science when he speaks of the confusion prevailing in science and complains that science is being overwhelmed by the activity of all sorts of fantasists. He exposes the anarchy and class character of bourgeois science when he regretfully states that these fantasists are assured of support "whilst on the other hand valuable scientific research workers with rich prospects are compelled to limit themselves or to cease work owing to lack of means". 22)

On the other hand, the testimony of the biologist Hans Driesch is interesting. Even before the flames of the Reichstag fired by the Storm-troopers lit up the progeny of fascist mediævalism, he complained bitterly that in Germany at least we are living in a time when interest in scientific knowledge is importunately and rudely pushed aside in favour of very vaguely expressed "cultural-philosophical" considerations. The desires and hopes of faith are mingled with real knowledge. This period of scientific and philosophical decadence will finish sometime. And then it will once more be recognised that the natural sciences with their strict method are the refuge of real knowledge. 23)

We will put aside the unintentional humour of the apostle of vitalism who deplores the mingling of faith and knowledge, philosophical and scientific decadence.

The important thing is to note the helplessness of the bourgeois savants which appears at the slightest attempt to analyse the causes and conditions of the crisis of bourgeois science.

On the other hand, the international character of this outstanding phenomenon of bourgeois culture, its bases and causes, is quite understandable in the light of Marxism-Leninism. This phenomenon fully confirms the philosophical and historical views of Marx and Lenin.

The general economic crisis which brings near the fatal hour of the expropriation of the expropriators, sets no great creative tasks before bourgeois science.

The upsetting and destruction of productive forces when demanded in the interests of private property, the fear of all innovation which is at the bottom of the theory of "the technical exhaustion of man", hold back the development of science or else give that development a one-sided character. Scientific workers have to justify their science by showing they are not guilty of the world crisis of capitalism (Emile Borel, etc.).

The class rule of the bourgeoisie has turned into a fetter on science. The bourgeoisie has worked science enough. It can be said without exaggeration that it develops it only so far as the interests of militarism and imperialism call for it.
The social conditions of the bourgeois world are unfavourable for the development of science. The reactionary character of the bourgeoisie which has suppressed with blood and iron the revolutionary movement of the proletariat and the colonial peoples, the reactionary nature of sections of the petit-bourgeoisie evoked by the ruin of the post-war epoch, the spirit of disillusionment, fatalism, mysticism (astrology, alchemy, magic, occultism, spiritualism, anthroposophy, etc.), spreading its poisonous colour over their background, all has a fatal influence on science and colours definitely the outlook which the scientific investigator constructs on the basis of modern science.

Chauvinism, the tendency to economic isolation (autarchy), the Balkanising of Europe, are all fetters on the development of science. They are obstacles to real scientific generalisation and the working out of a number of scientific problems which by their nature call for co-ordination, for a frankness which excludes secrecy, and for the co-operation of nations.

The division of labour, which has developed one-sidedly in bourgeois science, creates such minute specialities that they deepen the division between the different branches of even one and the same science, and the objective basis of crisis and reaction is also strengthened. The anarchy of bourgeois social relationships does not allow the planned organisation of the process of research, but private property in the instruments of research, the selection of cadres from the propertied classes, monopolises research activity, puts wide sections of workers outside its limits and is unable to guarantee the drawing into scientific work of capable and gifted human material.

If the research worker does not by his class nature express the reactionary moods of the ruling bourgeois, the external "bidding of capital" forces him along that path.

Fascist Germany with its superstition and utilisation of scientific theories in the struggle against the working class (genetics, the race theory, etc.), with its persecution of everything progressive in science, with its driving out of scientific workers who do not meet the conditions of the "third empire", is not an exception in the bourgeois world.

Fascist Germany as the rottenest link in world capitalism simply shows up more vividly and nakedly the situation of science and the scientific worker in bourgeois society.

In the historical sense the path of bourgeois science is completed. It has gone from Bacon of Verulam who boldly declared that "Scientia et potentia humans in idem coincident", past Oswald Spengler, the sentinel at the gate of the doomed Pompeii of bourgeois civilisation preaching a fight against technique and knowledge, down to similar familiars of fascism who see salvation in "collecting all books for the bonfire".

Modern bourgeois science confirms Lenin's teaching that a crisis of method is inevitably evoked by the progress of scientific knowledge in capitalist society.

This crisis in method becomes more profoundly acute and grows into a general crisis in outlook which is accompanied by a general stagnation and decline in scientific research, as the decay of the social and economic foundations of bourgeois society spreads in the period of general crisis of capitalism.

In the fifty years which have passed since Marx's death the ideas of this giant in thought have reached out in a way unprecedented in the history of the intellectual life of nations.

What do the views of the modern theoreticians of social-fascism have in common with Marx's teaching? What do their views on the chief problems of science have in common with Marx?

The theoreticians of the Second International themselves cynically admit their treachery in this sphere. They themselves proclaim that they have turned from "mechanical materialism to Machism and from Darwinism to neo-Lamarckianism".

Machism is the theoretical-cognitive basis of the scientific views of most of the social-fascist theorists. Their chief arguments are that a natural law is only a convenient way of describing phenomena and that any scientific picture of the world is absolutely conditioned by social relations.
These Machian vulgarisms, which have been pitilessly exposed by Lenin, deprive science of its objectively scientific meaning.

In the physical sciences the Machian arguments inevitably bring the social-fascist theoreticians to completely sharing the lot of the reactionary-minded bourgeois physicists who preach indeterminism and idealism.

Matter, mass, is only a complex of sensations. "Neither the eternal existence of mass, nor its metaphysical uncreatability and indestructibility are established; only the constancy of the relations of acceleration observed by man is revealed." (24)

In biology the social-fascist theoreticians stand on the extreme right wing even as a fraction inside bourgeois science. It is well known that Kautsky accepts the view of the eternity of life. In the theory of evolution Kautsky takes adaption to environment as his starting-point. So his departure from Darwin towards a neo-Lamarckianism of a psychological sort is defined. This also explains why the lesser social-fascist theorists like Gustav Eckstein and Hans Haustein refer to and support the vitalists like A. Pauly, E. Rignano, E. Hering, Semon, etc.

We know how Kautsky criticises the fascist racial theories; this criticism rather justifies and deepens them than exposes their scientific baselessness and reactionary character.

By refashioning Marx with neo-Lamarckianism, by biologising historical materialism, Kautsky has disarmed himself before the fascists Günther and Lenz. He is as close to them theoretically as he is politically.

There is no dirty and reactionary source in bourgeois science from which social-democratic theorists do not draw their wisdom. The famous "freedom" of social-fascist research shows itself by each one of them in his own way, with a greater or less degree of frankness, refuting and correcting Marx. Frederick Adler refutes Marx and Engels as mechanists. Max Adler directly and Kautsky indirectly, prove Marx always to have been an idealist (for Marx, according to these distorters, always started from needs, from man's purposive activity). These theorists have their shades of opinion and partial disagreements. Finally, they very often "partake of freedom" by an eclecticism which permits them to connect the inconnectible. But the general main line of their views in science is sufficiently clear and definite. It is in the main an idealist system of views. The social-fascists stand on the right wing of modern bourgeois scientific research workers and whole-heartedly share with them the burden of ideological dispersion and decline. They are "not antipodes but twins" (Stalin).

The dictatorship of the proletariat and the Soviet system bring forward new principles in the organisation of the process of scientific research. Unlike bourgeois scientific research which is partially dependent on the state but chiefly in the hands of private persons and various societies (including clerical ones), thereby excluding any possibility of planning and unity in work, socialism puts forward as its principles, instead of anarchy, a planned foundation, instead of spontaneity, social foresight, instead of one-sidedness, complexity, instead of the individualism of the competitive struggle, socialist competition and shock-work.

The philosophy of Marxism, dialectical materialism, the importance of which the mass of Soviet scientific workers recognise more and more, gives a precious weapon with which to generalise the latest facts of science, to justify theoretically the science of nature.

Science in these conditions provided by socialist society, assumes a particular power which distinguishes it in quality from bourgeois science. This is its greater activity, its greater tendency towards active interference in and changing of, those processes of nature which in the conditions of bourgeois society remain elemental and unrestrained.

The fiftieth anniversary of Marx's death almost coincides with the fifteenth year of Soviet power. The development of Soviet science in the fifteen years of its existence has fully justified Marx's views. Science in the U.S.S.R. has in this period won immense victories which have allowed it to a
great extent to overtake, and in some sections even to surpass, bourgeois science. These victories have been won not only in the field of the applied sciences, but also in the field of the theoretical sciences connected with them whose generalisations rise high above the practical interests of the present day. It is enough to recall the development of Soviet physics and chemistry, the study of radio-active substances, geology and geo-chemistry, the work in genetics, the experiments with mitogenetic rays, the theory of phylembyogenesis, the theory of conditioned reflexes, etc. Soviet science, from a mere appendage of European science, as it was before the November revolution, has become a strong force both within the country and in international science. These victories are the more remarkable for having been achieved in circumstances of civil war and intervention, of unceasing and desperate resistance from the remnants of the bourgeoisie defeated by the November revolution.

Notes

2) Stalin, *Problems of Leninism*.
5) See *Der lebendige Marxismus*, herausg, von O. Jenssen, Jena, 1924; *Das Weltbild des Kapitalismus*, Von Otto Bauer.
9) Lenin, *Materialism and Empirio-Criticism*.
12) Lenin, loc. cit.
17) *Das Lebensproblem*, etc., p. 214.
20) *Das Lebensproblem*, etc. Hans Driesch, *Das Wesen des Organismus*, p. 413.
21) See Scientia, I, iv, 1930; Charles Richet, Le problème des causes finales; ibid., I. vii, 1931; D. Kotzowsky, L’avenir de l’humanité civilise à la lumière des sciences modernes de la nature.

22) Wege zur Physik; Erkenntnis, loc. Cit., p. 269.

23) Scientia, I, i, 1932; H. Driesch; Eugenio Rignano’s Lehre, etc., p. 78.

24) Friedrich Adler, Friedrich Engels and die Naturwissenschaften, P. 175.

The three decades that have passed since the October days of 1917 have brought about, on the territory of the onetime Russian empire, such social and economic change, such historical developments, as to reshape the very foundations of life in the country. Never before has human history, has the development of society, witnessed such momentous revolutionary upheavals as this transformation of old Russia into a classless, socialist stale based on the broad democracy of the Stalin Constitution into a close-knit community of Soviet peoples, with a heroic army that has attained unexampled victory, with a huge new industry and an agriculture of an entirely new type.

The most far-reaching conclusions and forecasts of the teaching of Marx, Engels, Lenin and Stalin on the development of society have begun to be realized in the land of Soviets. For the first time in human history, scientific theory guides the building of a new slate.

And this mighty tide of history has carried with it, irresistibly, all science as a whole. Thirty Soviet years have effected a complete metamorphosis of science, both in scope and in nature. Of the scientific traditions of old Russia, only that which was progressive has gone on into the new life.

The extent and the substance of the changes that have taken place will be more easily grasped after a brief glance at the past, at the foots from which the new conditions have produced the Soviet science we Know today.

Science, in content, form, and purpose, is fundamentally social, collective. It is invariably, in its every branch, the sum of knowledge attained by many different people, by past generations and by contemporaries. It is the composite product of collective labours. The facts and conclusions which it comprises are expressed in the form of concepts, definitions, and formulae; they are recorded in writing or in print. The purpose of all this is to facilitate the communication of knowledge to other people, to one's class, one's stale, to humanity as a whole. Finally, and this is most important, science is a powerful instrument helping to disclose new productive forces in nature and new means of production. It gives man the means of struggle and of defence. Therefore, science comes into being and develops simultaneously with the rise and development of society, as an inevitable consequence and at the same time an indispensable condition for this development.

In Russia, the development of science began many centuries ago. Between the tenth and the twelfth centuries, it appears to have maintained the same level as in other European countries. For this we have the evidence both of writings of that period and of. material relics, particularly architectural. The invasion of the Tatars and Mongols, however, interrupted the normal growth of science in Russia. Progress was retarded for several centuries after. The rise of secular schools was hampered,
and the science of the churches and monasteries pursued aims' that had nothing in common with the progressive tendencies of natural science and technology. Clerical science was fettered and weighed down by Byzantine inertia and conservatism, by the "spiritual dictatorship of the church," as Engels puts it. Only in the seventeenth century did secular science begin to assert itself in Russia. One of its early expressions was the attempt of Boris Godunov to found a university in Moscow — a plan realized, somewhat later, in the founding of the "Slavo-Graeco-Latin Academy," Moscow's first institution of higher learning. Initially, of course, this institution was concerned only with teaching, and not with scientific research.

Science began to advance rapidly during the reign of Peter I, when the interests of the state called for a considerable expansion and consolidation of industry, commerce, and the art of warfare. Feudal Russia was a backward state, both economically and culturally, as compared with Western Europe. This was due, in considerable measure, to political causes of an extraneous nature. It should be remembered that the effects of the Tatar and Mongol incursions were not entirely wiped out in Russia until the latter part of the eighteenth century. In the meanwhile, during the sixteenth and seventeenth centuries, Western Europe, entering the capitalist phase of its history, had witnessed the growth of a new and remarkable natural science—the science of such men as Copernicus, Galileo, Kepler, Descartes, and Newton. Under Peter, however, this science, so new both in content and in style, took root in Russia with amazing rapidity. In the middle of the eighteenth century the St. Petersburg Academy of Sciences, which Peter had founded in 1725, was the scene of the scientific labours of M. V. Lomonosov, a man whose genius and achievements have been really grasped and appraised only in recent times, after a lapse of some two centuries. Lomonosov's work and attainments in the fields of physics, chemistry, astronomy, construction of instruments, geology, geography, language, and history would have done (honour to a whole academy, not to speak of one man. Pushkin called him "Russia's' university." He was the Russian people's swift response to the new opportunities for scientific development which had appeared, at long last, in the reign of Peter I.

Peter's foresight in basing the new Russian science on a central academy was completely justified in the course of the eighteenth century. The new Academy soon began to render useful service to the state in questions of technology and in the study of the country's geography, population, and natural resources. It set vigorously and successfully to work on the innumerable problems that had accumulated: questions of the Russian people's history and ethnography, of Russian grammar, of the country's climate. The St. Petersburg Academy members zealously promoted high school and university training for the youth. The Academy engaged in publication to an extent amazing for that period, bringing Russian society at large its first knowledge of the finest classics of science and literature. Members of the Academy initiated the organization of new scientific institutions, universities, and associations of scientists. In 1755, a university, proposed and planned by M. V. Lomonosov, was founded in Moscow. It was not long before this university became an important and independent scientific centre.

Unquestionably, in the period between its foundation and the end of the eighteenth century, the St. Petersburg Academy of Sciences contributed fundamentally to both Russian and world science. Here, on the banks of the Neva, native Russian scientists worked in close cooperation with foreign scientists, as for example Euler and Pallas, over the most important problems of science in that period. Here a strong foundation was built up for the atomic theory. It was here that the law of conservation of matter in chemical reactions was first proved experimentally, by M. V. Lomonosov. It was here that V. V. Petrov conducted his experiments directed against the phlogiston theory, and that physical chemistry took shape as a separate science. It was in St. Petersburg that Lomonosov established the existence of an atmosphere around the planet Venus. A wealth of important material concerning Russian flora, fauna, geography, and ethnography was compiled by S. P. Krashemrmikov, I. I. Lepekhin, N. Y. Ozeretsikovsky, V. M. Severgin, P. S. Pallas, and S. G. Gmelin. Of great significance were the investigations into Russian history conducted by V. N. Tatishchev, M. V. Lomonosov, and F. I. Miller. The profundity and importance of V. K.
Tredyakovsky's philological studies are only now beginning to be appreciated.

Peter's successors on the Russian throne did not share in his respect for science, did not realize its importance to the state. At best, they tolerated the Academy of Sciences as an appendage necessary for the adornment of a European court. The Academy, the universities, the scientific associations received very little real assistance, either moral or material, from the state. Men of science were left to their own resources. There was no longer that tie between science and the life of the state which Peter had had in mind in setting up the Academy.

This, at best negligent and contemptuous, attitude of the tsarist government towards the problems of science became traditional, persisting until the very eve of the October Revolution. Purely by inertia, certain appropriations for scientific work continued to figure in the state budget; but their amount would remain unchanged for decades on end. The new scientific centres taking shape in Kazan, Kharkov, Kiev, and other provincial towns had a difficult and uphill struggle to overcome, now the stubborn resistance, now the complete indifference, of the government. Scientific institutions were regarded principally as a supply centre for specialists, professors, teachers, engineers — categories that a modern European state could not very well get along without, whether it liked the idea or not. Research, creative scientific work, inventions, as a rule were deigned no notice, and even at best received but slight support and encouragement. But the Russian people had always been eager for knowledge, and what they had glimpsed of the nature and prospects of modern science intensified this urge. Self-taught inventors appeared. There was the famous Ivan Kulibin, of Nizhni Novgorod, and there was many another who unfortunately did not rise to fame, for lack of timely support. The provincial university newly established in distant Kazan fostered, the genius of that great Russian mathematician, N. I. Lobachevsky, who is often deservedly called "the Copernicus of geometry." Let the reader pause for a moment to realize how far Kazan was then removed from all cultural centres, how backward and isolated. Only then will he fully understand how remarkable it was that such a spot should produce Lobachevsky's subtle and penetrating mathematical concepts, concepts that for decades remained above the understanding of the world's greatest mathematicians. Some time later, this same Kazan produced and developed the splendid Russian school of chemistry which gave the world such men as N. N. Zinin, discoverer of aniline; A. M. Butlerov, one of the founders of modern organic chemistry; V. V. Markovnikov, and A. M. Zaitsev.

The class composition of the men of science in pre-revolutionary Russia was distinguished by the following important feature:

It was chiefly the "lower classes" — children of peasants, commoners, petty officials — that went in for scientific work with eager interest. So it was at the beginning of the eighteenth century, and so it continued for some two hundred years. Lomonosov was not the only man of science sprung from peasant stock. Few members of the ruling classes — the wealthy nobility and the bourgeoisie — allowed their children to devote themselves to learning. It was not a paying profession—Its prospects were hazy, and it involved hard work. Again, there were many who regarded science, not without foundation, as an ideological threat to their class rule. With the rise of the revolutionary movement in Russia, and the accentuation of class antagonisms, this feature of the composition of Russian scientific circles strongly influenced the development of Russian science, giving it a democratic trend. There was a comparatively narrow group of "official" scientists, which rendered loyal service to the forces of reaction and did its best to strangle every hint of progress and innovation in science; but the Russian scientists as a Whole were in a state of constant opposition — timid and covert, it is true — to the tsarist government, which failed to realize the importance of science and the prospects before it.

Towards the end of the eighteenth century, besides the St. Petersburg Academy, as the official, court representative of science, increasing importance began to attach to scientific beginnings in other parts of the country, and particularly in Moscow. When Moscow University celebrated its centenary, in 1855, its list of staff professors for the hundred-year period comprised 254 names, many those of
outstanding scientists in the different fields. The theory and history of literature: A. F. Merzlyakov, poet and scientist, himself a former student of the university, and Academy members S. P. Shevryrov and F. I. Buslayev. World history: Academy member M. P. Pogodin and Professor T. N. Granovsky. Russian history: among others, the famous Professor S. M. Solovyo. Physics and mathematics: the well-known astronomer D. M. Perevozhikov; the mathematician and physicist N. D. Brashman; the gifted physicist, philosopher, and agricultural expert M. G. Pavlov; the eminent physicist and meteorologist M. F. Spassky. Biology: the zoologist K. F. Rulye. Thus, science in Moscow was growing and developing in every field.

The nineteenth century, age of development of capitalism, of steam and electricity, brought a new advance of science and technology in Western Europe, which, in the latter part of the century, spread also to America and Japan. Russia, too, experienced a rising tide of scientific activity. Splendid new men came to the fore in all the country's scientific centres — in the Academy, the universities and the specialized institutions of higher learning. The work of N. I. Lobachevsky in the field of geometry, and of M. V. Ostrogradsky, Sophia Kovalevskaya, and P. L. Chebyshev in mathematical analysis, sent the fame of Russian mathematics ringing round the world. Many remarkable discoveries were made in the field of technical physics. The voltaic arc was produced, for the first time in history, by L. Y. Kraft and V. V. Petrov. Academy member B. S. Jaeobi discovered and developed the technique of galvano-plastics, and constructed an original telegraph and the first motorboat, besides many other important practical discoveries. It was in Russia that the first practical sources of electric light came into being: P. N. Yablochkov's arc candle, and A. N. Lodgyin's incandescent lamp, the first of its kind. Radio was first discovered by the Russian A. S. Popov. Academy member and St. Petersburg University professor E. G. Lenz was one of the founders of classical electromagnetism (Lenz's law and rules). The greatest discovery of the nineteenth century in the field of chemistry — the periodic table of chemical elements — was made in St. Petersburg, by D. I. Mendeleev. The Pulkovo Observatory, built towards the middle of the century, was for several decades the "astronomical capital of the world." Fundamental discoveries in the fields of embryology, microbiology, and physiology are bound up with the names of the great Russian biologists — K. Baer, A. O. Kovalevsky, I. I. Mechnikov, S. N. Vinogradskj, I. M. Sechenov, I. P. Pavlov. Geographical, ethnographical and archeological discoveries of great importance were made by N. M. Przevalsky, N. N. Miklukho-Maklay, P. A. Kropotkin, P. K. Kozlov, and others. Nineteenth-century Russian science made basic contributions in the fields of orientalogy, language, and Russian and world history. It is impossible in so brief an article even to list all the outstanding scientific achievements attained by Russian scientists in various fields in the course of the nineteenth century.

Surely, eloquent testimony to the Russian people's urge for knowledge, to their talent and ability! In spite of all this, however, Russian science in the nineteenth century did not become the powerful force it might have been, did not develop into a comprehensive, consistent, and systematic movement. It was not sufficiently bound up with life, and failed to produce what might be called, in chemical terms, a "chain" process of development of science and technology in Russia. It was no more, than the mechanical sum of the activities of individual outstanding scientists. Only in rare cases were scientists able to found schools, to find assistants and disciples who would carry on their work. Many an important labour begun by a Russian scientist ceased with its author's death and was consigned to oblivion. Sometimes, such works were continued — abroad. This situation was caused, first and foremost, by the tsarist government's failure to appreciate Russian science, by the contempt and suspicion in which it held native endeavour and prospects. As the need for science and technology developed, the government preferred to import them, ready-made, from abroad; and Russian scientific labours, as a rule, received none but the most insignificant material assistance from the government. Scientific research, as a profession, was limited to a very small number of persons who were retained in the universities for post-graduate work, budget appropriations for which were less than negligible. Most of the young people graduating from colleges and universities entered the fields of school teaching or industry, or engaged in other practical activities
very far removed from science. Thus, Russia in the nineteenth century had many brilliant scientists and could pride herself upon a lengthy roll of momentous discoveries and inventions; but, with only rare exceptions, she had no systematically developing national science.

This discrepancy between the people's latent abilities, their aspiration to knowledge, on the one hand, and the lack of government support, on the other, became particularly marked during the last few decades before the revolution. In this period we note numerous and broadly conceived attempts to create, besides the official science vegetating in state institutions, a science supported by the public, independent of government subsidies. Numerous private colleges appeared in St. Petersburg, Moscow, and other cities. Particularly successful in St. Petersburg were the Bestuzhev courses, and the Psycho-Neurological Institute founded by Professor Lesgaft. In Moscow, a private university for women (the Women's Higher Courses) was founded and developed rapidly. There were also the Gerye courses, and the Golitsyn agricultural courses. Each of these schools offered a systematic higher education in one or several fields. Again, besides such higher schools of the generally accepted type, institutions known as "people's universities" began to spring up, almost spontaneously, in a number of cities, particularly Moscow. The people's universities engaged in the organization of popular lectures, in cycles covering the various fields of learning and on individual scientific problems. Delivered by prominent men of science and university professors, these lectures proved a great success, and regularly drew large audiences, not only of intellectuals, but also of advanced workers. Some of the people's universities also organized laboratory work, and even trips through Russia and abroad devoted to the study of botany, geology, archaeology, and the arts. In 1911, on funds contributed by A. L. Shanyavsky, a large building was erected on the Miuss Square, Moscow, to be used as a popular university. The Shanyavsky university had well-equipped lecture halls and laboratories, and a very good library. Active centres of interesting and useful work were the scientific societies — for example, the Society of Amateurs in the Natural Sciences, Anthropology, and Ethnography, and the Natural History Society, both in Moscow. The first-named society founded an institution, the Polytechnical Museum, which to this day promotes the dissemination of scientific and technological knowledge among the population of Moscow. A society of this type would comprise a number of groups, devoted to various ramifications of its chosen field of work. At their meetings, these groups engaged in lively discussions of the latest works of Moscow scientists. Many, of the city's most prominent men of science were active participants in these societies, among them the renowned botanist K. A. Timiryazev, the eminent physicist P. N. Lebedev, and the founder of Russian aeronautics, N. E. Zhukovsky. Important work was done in St. Petersburg by the Russian Physical and Chemical Society, which united the labours of all the physicists and chemists of the period. There were also active scientific societies in Kazan, Kharkov, Nizhni Novgorod and a number of other cities. An even more vivid indication of public interest in science were the big St. Petersburg and Moscow congresses of naturalists and physicians. In all, there were twelve such congresses, of which the last, convened in Moscow at the very end of 1909, was particularly indicative. This congress had an attendance of something like six thousand. In other words, it attracted almost all the country's scientific forces in the field of medicine and natural history, down to university students of the graduating classes. Its general meetings heard reports on the most debated scientific topics of the day: on high nervous activity, by Academy member I. P. Pavlov, and on the theory of relativity, by N. A. Umov, professor of physics at Moscow University. At a session of the physics section, P. N. Lebedev reported on his amazingly delicate and important experiments in the field of light pressure. The twelfth congress of naturalists and physicians was the last and most impressive demonstration of the vigour and the quality of Russian science before the revolution.

A year after this congress, however, Moscow was the scene of events which reflected all too clearly the tragic situation of science in tsarist Russia. Student unrest at Moscow University, which was brought to the surface' towards the end of 1910 in connection with the death of Tolstoy, was seized upon by the Moscow police as a pretext for invading the university. Police officers, and even the Moscow Chief of Police himself, began to appear in the professors' stands in the lecture halls where
the students held their meetings. The rectors (Professor A. A. Manuilov, Academy member V. I. Vernadsky, and Professor P. A. Minakov) and most of the progressively-minded professors handed in their resignations, which were at once accepted by the Ministry of Public Education, then headed by Professor Kasso. Thus, for many years to come — in fact, until the revolution — Moscow University was deprived of the very core of its teaching staff. Outstanding scientists were replaced by the first chance applicants. Scientific activity declined almost to nil. In order to train young scientists, the Ministry of Public Education was obliged to select politically unsuspect groups from among the graduating students and send them abroad to study, as in the days of Peter I.

Symptomatic of the period between the revolutions of 1905 and October 1917 was the immediate public support accorded to the scientists resigning from Moscow University. Many of these men continued teaching, and resumed their research work, in the private colleges mentioned above, or in the Shanyavsky people's university. Even the Imperial Academy of Sciences, or rather, the more liberally inclined of its members, made an effort to assist them. Considerable funds were collected for the building of research institutes, two of which (the Institute of Physics, on Miuss Square, and the Institute of Experimental Biology, on Vorontsovo Polye) were actually completed just before the October Revolution. Among the men who left Moscow University was the brilliant Russian physicist, and experimenter P. N. Lebedev, who has already been mentioned above. Lebedev continued his work in a basement apartment in one of Moscow's side streets (at No. 20, Myortvy Lane). This basement was the scene of his last experiments, an interesting research into the nature of terrestrial magnetism. On March 14, 1912, Lebedev died. He was only 46, and it is hardly to be doubted that his death was hastened by the tragedy of Moscow University.

Publicly supported scientific activities continued to develop, despite the obstacles which the government put in their way, and during the first world war rendered considerable assistance to the front. Such public organizations as the Zemstvo Union and the Union of Towns sponsored scientific work on the development of gas masks and organized the manufacture of X-ray apparatus, telephones, thermometers, etc. In Petrograd, the Academy of Sciences promoted public effort by organizing a large committee for the study of Russia's natural productive forces. The numerous sections of this committee engaged in the study of problems of technical physics, geology, and chemistry, the solution of which was of great assistance to the country's war industries.

And this wartime public scientific effort subsequently became a factor in many respects facilitating the accomplishment of the tremendous tasks which confronted science immediately after the victory of the socialist revolution.

The qualitative level of Russian science in the last decade preceding the revolution was very high. Brilliant work was being done in mathematics and mechanics by A. M. Lyapunov and A. N. Krylov, and in mathematical analysis, in particular, by that outstanding mathematician, V. A. Steklov. Theoretical discoveries of tremendous practical importance in the field of aerodynamics were made by N. E. Zhukovsky, S. A. Chaplygin, and K. E. Tsiolkovsky. P. N. Lebedev's work on ultra-short radio waves and on light pressure made him famous as one of the world's finest experimentators. The attainments of the older generation of physicists were paralleled by a number of important works that brought prominence to scientists of the rising generation. Such were P. P. Lazarev, who initiated modern physical research into photochemical processes; D. S. Rozhdestvensky, who elaborated an ingenious method, since established as a classic, for the quantitative determination of anomalous dispersion of metal vapour; A. F. Joffe, who became widely known for his experiments in the field of photoelectricity and the physics of crystals. In the natural sciences, Russia could boast such men as K. A. Timiryazev, then engaged in his immortal research into vegetable photosynthesis; the famous selectionist and geneticist I. V. Michurin, and the Darwinian zoologists M. A. Menzbir and A. N. Severtsov. In the field of geology and mineralogy, the Russian natural sciences were represented by the famous crystallographer E. F. Fyodorov; by the "father of Russian geology," A. P. Karpinsky, and by the founders of geochemistry, A. E. Fersman and V. I. Vernadsky.

At the same time, the Russian scientists were constantly haunted by a sense of futility, of
unwantedness, of divorcement from their native soil — the inevitable consequence of old Russia's social order and of the tsarist government's fatuous disregard of science. On January 13, 1905 (Old Style), just a few days after the tragedy of Bloody Sunday, P., N. Lebedev wrote from Moscow to his old friend, Academy member B. B. Golitsyn, in St. Petersburg: "All my efforts to cultivate science in my beloved motherland strike me as a sort of insipid and useless waste of time. I feel that as a scientist I am perishing, beyond salvation. The life that surrounds me is an interminable, stupefying nightmare, hopeless despair. If there is any talk in the Academy about the advance of science in Russia, tell them, from an unhappy Moscow professor, that there is nothing of the kind — no advance, no science, nothing."

These lines were written six years before the police invasion of Moscow University. Coming as they do from the pen of a famous Russian physicist, they speak eloquently of the tragic gulf that separated science and scientists, on the one hand, and the state, on the other, in pre-revolutionary times.

The extensive publicly supported scientific activities briefly described above, activities always, openly or covertly, directed against the tsarist government, yielded rich fruit when the barriers isolating science from the people were broken down by the proletarian revolution.

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The storm that finally broke over Russia in October 1917 put an end to the past and introduced an altogether new life.

To the victorious revolution, science was indispensable for the consolidation of victory and the advance of the new state. The educational level of the masses had to be raised, the semi-literacy handed down from the past to be wiped out, without delay. And the first requirement for this end was schools, schools of every type — elementary, secondary, higher. Teachers and professors had to be trained in tremendous numbers to fill the gap in pedagogical forces. Again, it was urgently necessary that productivity be raised as rapidly as possible, that new productive forces be sought out and brought into use, that the means of production be improved and multiplied. For this, too, science was needed — science untrammeled, research workers, engineers. Scientific institutes and laboratories had to be built and equipped to meet the new requirements.

Barely established, the young Soviet Republic found itself encircled by a hostile ring of imperialist powers. Forces of intervention invaded Soviet territory and came to the support of the Whiteguard armies. Defence became the order of the day. And in defence as well science was indispensable, improving and modernizing military equipment.

In technology and the natural sciences, much of the heritage coming down from pre-revolutionary learning and of the attainments of science in other countries could be put to work in the titanic labour of building the socialist state. In the social sciences, however, the situation was very different.

The development of Russian science, and particularly of the materialist natural sciences, was strongly and beneficently influenced by the works and ideas of the great Russian revolutionary democrats — Belinsky, Herzen, Chernyshevsky, Dobrolyubov, and the pioneer of Marxism in our country — Plekhanov. It was Russia that gave the world the genius of Lenin and Stalin, those great men of science, who further developed the immortal teachings of Marx and Engels and blazed new trails in human history. In the universities and in the Academy, however, the content and structure of the social sciences were moulded to a very great extent by the class views of the capitalist society which had produced them. The idealist philosophy, which, in one form or another, reigned supreme in the Russian universities before the revolution, was a philosophy of a clearly expressed class nature, a fallacious philosophy, hostile to revolutionary consciousness. It was in line with an entirely different philosophy, the dialectical and historical materialism of Marx, Engels, Lenin and Stalin, that the socialist revolution grew and developed. Hence, there was to follow a protracted
battle of ideas. Philosophy, history, economics, law all the social sciences — called for swift and radical revision. The science of history as developed in old Russia unquestionably had substantial achievements to its credit so far as the accumulation of factual material was concerned. But the treatment of this material, its interpretation, the theory of historical development applied to it reflected the interests of the nobility and the bourgeoisie. Much that was contained in this science called for revision and renewal. Still more evident was this necessity for fundamental revision in the field of economics and law, which had to be virtually created anew in the conditions prevailing in the world's first classless, socialist state. A new, Marxist-Leninist science was needed here.

Thus, while the natural sciences and technology, for the beginning, at any rate, called only for serious attention, encouragement and material support, the social sciences required a fundamental revision of all that had been handed down from the past.

From the very first days of Soviet rule, it became clear to scientists in Russia that an entirely new phase had begun in scientific development. In the Soviet, socialist state scientific effort was no longer dependent on private initiative or "philanthropical" support. It became ever more clearly an affair of state, a matter of the first importance, an object of particular solicitude to the Soviet government and the Communist Party.

The great majority of Russia's scientists, old and young, realized quickly enough the significance of the great change that had taken place, and appreciated the prospects opening up for science. These scientists soon set to work in the new conditions.

One of the first manifestations of this altogether new turn in the history of science was the rapid organization of large numbers of research institutes. To the tsarist government, as we have already noted, scientific institutions were little more than centres for supplying the necessary teachers, professors, and engineers. Scientific research, the quest of the new, the blazing of trails in science were regarded as the scientist's private affair, not as an essential part of his profession. As a result of this, research, not only in the universities and colleges, but even in the Academy, was generally episodic, confined to scattered individual efforts — what might today be called: "outside the plan."

Neither the proper equipment nor the necessary auxiliary personnel were available for scientific work. Such were Mendeleyev's working conditions, Timiryazev's, Pavlov's. Such were the conditions for most of the Russian scientists. P. N. Lebedev was perhaps the first, and almost the only scientist in old Russia who succeeded, despite these difficulties, in founding his own scientific school. He organized a laboratory of considerable size, in which a large number of students and young scientists worked under his guidance. Even in this case, however, the Moscow University Institute of Physics could find no better accommodation for the remarkable works of Lebedev and his pupils than a basement room; and after the events at Moscow University the laboratory was broken up, and had to be reorganized on private funds, in a private apartment.

The changed status of science under Soviet rule was immediately apparent in the radically new attitude of the government towards scientific research and its role in the life of the state. From the very beginning, the Party and the government provided extensive and concrete means for the organization of large research institutes, to be independent both of the universities and of the Academy. The first few years of Soviet rule brought into being an entirely new network of scientific institutions — specialized research institutes. The first of these to be organized was the Institute of Physics in Moscow, headed by P. P. Lazarev, based on the privately endowed Institute of Physics that had been established to carry on the work of Lebedev's laboratory. Then, in Petrograd, came the Physico-Technical Institute, headed by A. F. Joffe, and the State Optical Institute, headed by D. S. Rozhdestvensky. Soon afterwards, the Central Aerohydrodynamics Institute (TSAGI) was set up in Moscow, —with N. E. Zhukovsky and S. A. Chaplygin as its leading spirits. Then came the All-Union Electro-Technical Institute, in Moscow, headed by K. A. Krug. Big research institutes soon began to appear in other fields of science as well — chemistry, biology, geology. All these institutes were organized and equipped with amazing speed. The Soviet government's appropriations for science were far beyond anything Russia had seen before.
A distinctive feature of the new institutes was the close contact they maintained, through the people's commissariats and the plants and factories, with the targets and problems of the national economy. They became an important link between science and the needs of the state. Thus, the Central Aerohydrodynamics Institute laid the groundwork for the huge Soviet aviation industry. The State Optical Institute rendered great assistance in the development of the optical industry and the improvement of its output. The AH-Union Electro-Technical Institute paved the way for a national electrical industry. The work of the Karpov Chemical Institute, in Moscow, promoted the development and consolidation of various branches of the chemical industry. The Institute of Plant Breeding worked on the problems of intensified farming. Nor did these practical activities crowd out theoretical work, Which also brought splendid results. The institutes became an excellent training school for new scientific personnel recruited from the student and factory youth. And so, around the old Academy of Sciences — former monopolist in the field of purely research institutions — there grew up a large and varied network of scientific centres of an entirely new type, engaged in vigorous research work.

But the Academy, too, had been changing fundamentally since the establishment of Soviet rule. Early in 1918, the Academy of Sciences addressed itself to the Soviet government, expressing its readiness to participate in economic, statistical, and cartographical activities and to undertake research in the field of mineral resources, power production, irrigation, and agriculture. Accepting this offer, the Council of People's Commissars adopted a decision providing for the necessary assistance to the Academy. A rough plan for the Academy, in Lenin's hand, exists to this day — a remarkable document, proposing that the Academy of Sciences be called upon:

"To set up a number of committees of experts to draw up, as quickly as possible, a plan for the reorganization of industry and economic revival in Russia.

"This plan should provide for:

"Rational distribution of industry in Russia from the point of view of proximity of raw materials and minimum waste of labour in the passage of the raw materials from the initial processing to all subsequent stages of manufacture, up to the final product.

"Rational — from the point of view of the most up-to-date., largest-scale industry, and particularly trusts — amalgamation and concentration of production in a small number of big enterprises.

"Securing the present Russian Soviet Republic (without the Ukraine and without the German-occupied regions) the maximum possibility to supply itself independently with nil the most important types of raw materials and industry.

"Particular attention to the electrification of industry and transport and the application of electricity in agriculture. The utilization of the poorer grades of fuel (peat, low grades of coal) to produce electric power with the minimum expenditure on the extraction and transportation of fuel.

"Water power and wind-driven motors generally and as applied to agriculture."

And the Academy attacked the problems set before it, to the extent of its abilities at that time. Ethnographical tables and charts were drawn up, and special committees set to work on the simplification of Russian spelling and the reform of the calendar. Despite the difficulties caused by civil war, the Academy undertook a thoroughgoing investigation of the Kursk magnetic anomaly, which led to the discovery of enormous deposits of iron ore, hitherto unknown. This work was directed by Academy member P. P. Lazarev. who had the active assistance of Academy member A. N. Krylov and of many geologists and geophysicists. A geological survey of the Kola Peninsula, under Academy member A. E. Fersman, brought to light large apatite deposits.

The tiny laboratories of individual Academy members, the Academy's departments and museums, underwent a rapid transformation, growing up into scientific institutes, plentifully staffed and supplied with new equipment, facing entirely new tasks. Thus, the old physics laboratory became the Institute of Physics and Mathematics, headed, at first, by Academy member V. A. Steklov. Later,
it was reorganized into three separate institutes: the Lebedev Institute of Physics, the Steklov Institute of Mathematics, and the Seismological Institute. At the proposal of Academy member N. S. Kurnakov, an Institute of Physical and Chemical Analysis was set up. Professor L. A. Chugayev became the head of the new Platinum Institute, which, besides its specific study of platinum, engages in a profound investigation of complex chemical compounds. Academy member V. I. Vernadsky became the head of the Radium Institute. I. P. Pavlov's physiological laboratory grew into a big Physiological Institute. To further the study of language and mentality, Academy member N. Y. Marr organized within the Academy of Sciences the Institute of Language and Mentality, which has elaborated a new theory initiated by its founder. Thus the Academy, formerly at the head of little more than deserted museums, archives, and libraries, was transformed into a broad association of research institutes, populous and active, pursuing clearly defined aims in clearly defined fields.

The Soviet state devoted great attention to the schooling system.

"We can build Communism," said Lenin, in his speech at the Third All-Russian Congress of the Young Communist League, on October 2, 1920, "only from the sum of knowledge, organizations and institutions, only with the stock of human forces and means that were bequeathed to us by the old society. Only by radically recasting the teaching, organization and training of the youth can we ensure that the result of the efforts of the younger generation will be the creation of a society that will be unlike the old society, i.e., a communist society."

New colleges and universities sprang up in all parts of the country. In some cases, these were even organized too hastily, and insufficiently staffed. Trained people were needed, desperately needed, and people were trained by every possible means, including the organization of short-term courses to supplement the ordinary higher schools. The need for teaching personnel in the higher schools was aggravated by the fact that many professors and lecturers had shifted their scientific activities from the old higher schools to the new research institutes in the various branches. But the problem of personnel, desperate as it may at first have seemed, was solved. Within the first decade after the revolution the number of scientific workers — i.e., of persons actively and successfully engaged in research increased some ten times over, at the very least, as compared with, pre-revolutionary times. It may be said that this eager advance of science in the first years of Soviet rule took as its motto the following statement, made by Lenin at a meeting held in Petrograd on March 13, 1919:

"We must take the entire culture that, capitalism left behind and build Socialism with it. We must take all its science and technique, all its knowledge and art. Otherwise we shall not be able to build communist society. And this science, technique, and art are in the hands and in the heads of the experts."

The first Soviet years, the years of civil war and of struggle against the intervention, were a period in themselves for science. At this time the Soviet Union was cut off from the outer world by a hostile capitalist blockade. Hence, no new scientific literature or equipment came into the country, and in this sense, for several years, Soviet science was completely isolated, left to make its way alone. Yet, even in these difficult and exceptional conditions, scientific work not only continued, but developed far more extensively than before the revolution. This period produced a number of works of great moment. It was at this time, for example, that Academy member V. A. Steklov published his research in mathematical physics, and the theoretical physicist A. A. Friedman his important amendments to the general theory of relativity. In Leningrad, the study of atomic structure was undertaken on a broad scale. D. S. Rozhdestvensky arrived at very interesting conclusions concerning what is called the fine structure of spectrum lines. When communication with foreign countries was renewed, it transpired that the Soviet physicists, working entirely independently, had in many respects advanced the study of atomic structure. We have already mentioned the thorough experimental investigation of the Kursk magnetic anomaly. In wealth of material, and in the quality of this material, the Kursk investigation has served as a model for many succeeding works of this nature. The chemistry of complex compounds was greatly advanced by the work of Chugayev and
his school. It was in this period, too, on the instructions of V. I. Lenin and J. V. Stalin, that a group of Soviet electrical engineers, technologists, economists, hydrotechnicians, and construction engineers elaborated the renowned GOELRO plan for the electrification of Russia, of which Stalin wrote:

"A masterly draft of a really unified, a really state economic plan. ... The only Marxist attempt in our day to build up for the Soviet superstructure of economically backward Russia a really practical technical and production foundation — the only foundation feasible in the present conditions."

This intensive and absorbing work stimulated the growth of new scientific cadres. Young people came pouring into the classrooms and laboratories of the newly organized institutes. They helped to equip the institutes, and, simultaneously with their studies, contributed to the advancement of science. The publication of scientific literature, both original and translated, grew to unprecedented dimensions. Branches of industry which technical backwardness, prior to the revolution, had kept in an embryonic state, now rapidly developed and grew. Such, for example, were the electrical and optical industries. Suffice it to say that before the revolution the country was unable to produce incandescent electric bulbs. Tentative efforts undertaken in this direction shortly before the revolution were a complete failure. In the new conditions, this problem was soon solved, and it was only a few years before the country was fully supplied with bulbs of domestic manufacture. Again, Russia before the revolution had almost no experts in the field of optical instruments. There were but a few small workshops producing such instruments, and even these were mere branches of foreign firms. In the new conditions, experts were soon trained, and the technological difficulties connected with the manufacture of optical glass overcome. The Soviet optical industry began to stand on its own legs. After about ten years, our country no longer had to buy optical glass abroad, though many other countries, both in Europe and in the Americas, still depended on such imports. The chemical industry, too, developed rapidly.

In 1925 the Russian Academy of Sciences celebrated its bicentenary. In connection with this anniversary, it was renamed, now becoming the All-Union Academy of Sciences. The bicentenary festivities, a landmark in scientific life both in the Soviet Union and internationally, were attended by representatives from many lands. A high point of the celebration was the speech delivered by M. I. Kalinin. Congratulating the Academy on behalf of the Soviet government, Kalinin declared that "socialist society, more than any other form of society, urgently requires the broad development of both the abstract and the applied sciences; and it is the first form of society to create for scientific thought and labours genuine freedom and fruitful contact with the masses." On acquaintance with academic institutions, and also with the new, independent institutes which had sprung up since the establishment of Soviet power, it became clear to the assembled scientists, Soviet and foreign, that in a few short years Russia's old science, so limited despite its merits, had grown up into a big new science, steadily and rapidly advancing a science now not only in scope, but in its very nature. Science had become the property of the people, accessible to all who had the desire and the ability to undertake such work. Every year increased the proportion of students and scientists coming from the working class and the peasantry, both in the universities and colleges and in the research institutes. From the very outset, popularization of science was undertaken on a wide scale. Besides the extensive publication of popular scientific literature and the organization of lectures, this included such methods as the despatch of railroad cars, fitted up with graphic displays aimed to popularize various branches of science, to all parts of the country. Again, with the advance of radio, the Soviet government received still another powerful instrument of political and scientific propaganda.

Another peculiarity of Soviet science was its "practicism" — its contact with the national economy, and its work on problems set by government departments and by branches of industry. Science was definitely entering into the service of the socialist state.

A new method, applied more and more frequently, was that of collective work, in which the solution of a problem would be undertaken, not by one individual, but by a group of scientists, usually
headed by a prominent specialist in the field. This method of work made it possible to undertake intricate and laborious research which had formerly seemed impossible.

At the same time Soviet science produced many weighty and outstanding individual works. Academy member A. F. Joffe launched a new approach to that major problem of physics and technology, the strength of crystals, which he attacked by original and ingenious methods of experiment. The young physicist D. V. Skobeltsin (since elected to the Academy) worked out a new and extraordinarily productive method for the study of elementary charged particles in the Wilson chamber in magnetic fields— By this method, Skobeltsin produced the world's first clear and convincing proof of the existence of cosmic rays, and discovered a number of phenomena, hitherto unknown, connected with these rays. It was in this period that Academy member S. V. Lebedev began his efforts to produce synthetic rubber, which were, to culminate so successfully. In this period, too, I. P. Pavlov and his pupils continued their remarkable study of conditioned reflexes, and N. Y. Man's new theory of language was greatly advanced. Soviet science was gaining strength and rallying cadres. It could now go on to the solution, of new problems of great importance to the state.

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The first decade of Soviet rule began with a period in which the revolution, politically victorious, had to be defended with arms in hand against its enemies, within and without. Then came a period of reconstruction of the national economy, which had been reduced to ruin as a result of the first world war and the civil war. In many instances science, now rapidly progressing, was able to afford concrete assistance in the reconstruction work in industry, transport, and agriculture, not to speak of its contribution to the people's cultural advancement. Still, the development of science in this first decade was uneven, unsystematic, sometimes entirely spontaneous. Science in the first Soviet decade was not planned and integrated as it is today.

At length, however, the reconstruction work approached completion. The national economy neared its pre-war level, i.e. the state of Russia as of 1913. This fell far short even of the most moderate desideratum. There could be no question, of course, of stopping here. The country was confronted with the urgent task of building up an economy of an entirely new scope, of an entirely new type — the economy of the socialist state. In December 1925, at the fourteenth congress of the Communist Party, Stalin advanced the slogan of industrialization, formulating the work to be done in the next few years in the statement:
"The conversion of our country from an agrarian into an industrial country able to produce the machinery it needs by its own efforts — that is the essence, the basis of our general line."

Now began a period of intense labour by the whole people, workers, peasants, intellectuals, unswervingly directed towards socialist industrialization.

First of all, the country had to build up a heavy industry — a task of no mean size and difficulty. If the U.S.S.R. was to be independent of the capitalist world, big machine-building, machine-tool, iron and steel, and electrotechnical plants had to be built without delay, and new sources of power to be found and put into use as quickly as possible. Coal and oil output had to be increased, and huge dams and other hydrotechnical projects built. Metals, ferrous and nonferrous, were needed in tremendous quantities.

Down through the ages, Russia had always been an agrarian land. Side, by side with the development of industry, therefore, there arose the problem of stimulating agricultural productivity. And the fifteenth Party congress, in December 1927, adopted a decision, proposed by Stalin, calling for the energetic development of collective agriculture. There followed an extraordinary increase in the demand for agricultural machinery, particularly tractors. Huge tractor plants had to be built to satisfy this need.

The decisions on the industrialization of the country and the collectivization of agriculture were the precursors of the live-year plans. A further decision adopted by the fifteenth Party congress, also on
Stalin's suggestion, called upon the State Planning Commission to draft the first five-year plan for the national economy.

In April 1929 the first Stalin five-year plan was approved and adopted.

"The fundamental task of the five-year plan," Stalin pointed out in later years, "was to create such an industry in our country as would be able to re-equip and reorganize, not only the whole of industry, but also transport and agriculture — on the basis of Socialism."

The plan was grandly conceived. And it was carried out, not in five years, but in four. It was followed by a second five-year plan, and a third. With their accomplishment, Socialism was built in our country, and classless society established.

The system of extensive national economic plans calculated for several years ahead brought a new era in Soviet science and technology. The state called upon scientists and engineers for the urgent solution of big new problems, of signal importance in the fulfilment of the five-year plans. And, inevitably, these calls of the state brought the planning principle into science as well.

To Soviet scientists, the past decades have made the idea of planning in science a natural and accustomed concept, an essential attribute to their work. Abroad, however, this idea continues to be a subject of heated debate, arousing no little ideological opposition. An important factor conditioning this refusal to accept and understand the idea of planning in science is to be sought in the individualistic traits of capitalist society, in the cult of private property. Every advance in science, every new scientific idea and invention, in capitalist society, is regarded as an item of private property. The state has no jurisdiction over it, and its development, consequently, cannot be planned. There is no possibility, of course, of planning out "unexpected" scientific results and discoveries; but all true science must contain a very large proportion of well-founded anticipation and prevision. In the seventeenth and eighteenth centuries, for example, Newton's physics might have served as a basis for predicting, and hence planning, the development of physics for a long time ahead. Our contemporary knowledge of the structure of the atom nucleus allows us to plan out for many years to come, with a large degree of confidence, much of the theoretical and experimental work to be done in this field. Contemporary organic chemistry is so constructed that we can see clearly into the future, selecting the most expedient and interesting directions for development in both the practical and the theoretical sphere. In aeroplane construction, empirical formulae have actually been worked out indicating the increase in power of aeroplane motors with the passage of time. Planning is fully warranted, even essential, in a number of branches of biology, as for example in animal and plant selection, when the question arises as to the desirability of producing one or another breed or type.

And the complete dedication of our science to the service of the people and the state has made planning in science an absolute necessity. That is one of the chief distinguishing features of science! in the socialist: state. Such planning includes not only scope — institutions, personnel, equipment — but also content, i.e., the themes of scientific research.

The plan of scientific development in a socialist state must, of course, link up with the state economic plan; but it should not be forgotten that the prospects opened up by the constant growth of science will often considerably exceed the prospects outlined in economic planning. Science has its own peculiar logic of development, a logic which it is essential to take into account. Science must always work ahead, accumulating reserves for the future; only then will it be working in its natural element.

The definite transition to the planning principle was the chief distinguishing feature of Soviet science during its second period of its development, approximately coinciding with the second decade of Soviet rule. Another important feature of this period was the gradual decentralization of science, the appearance of new hubs of scientific activity. It was at this time that the Academy of Sciences of the U.S.S.R. set up its first branches: the Far-Eastern branch, in Vladivostok; the Urals branch, in Sverdlovsk; the Georgian branch, in Tbilisi; the Armenian branch, in Erevan; the
Azerbaijanian branch, in Baku, and the Kazakh branch, in Alma-Ata. These were designed to promote the development of scientific research in various directions, as determined by local conditions and requirements; they provided a research set-up to complement the existing local universities and colleges. In the course of time, the branches fully justified their existence. They concentrated the work of local scientists, trained new forces from among the local population, and soon began to produce important results, both theoretical and practical. In later years a number of these branches developed to a point at which they could be reorganized as independent Academies. The decentralization of science affected not only the Academy, but also the network of specialized research institutes. Several big institutes of this type came into being in different parts of the country under the five-year plans. Special mention should be made of the physico-technical institutes in Kharkov, Dniepropetrovsk, Sverdlovsk and Tomsk, the organization and staffing of which were greatly facilitated by preparatory work conducted by the Leningrad Physico-Technical Institute, under Academy member A. F. Joffe. These four institutes became important scientific centres, and in a brief space of time produced results of considerable significance. Big agricultural institutes were also set up in various parts of the country, in Omsk and Odessa, for example, as well as a number of other institutes in various branches and specialties.

A third distinguishing feature of Soviet science in the period of the first Stalin five-year plans was the great increase in the number of universities and colleges and in the student body. Pre-revolutionary Russia could boast only 91 universities and colleges, with a student body of some 112,000 (figures for 1914-1915). When the first five-year plan was launched, in 1928-1929, the student body numbered about 177,000. By the beginning of the second five-year plan, in 1933-1934, this figure had jumped to 504,000. By the beginning of the third five-year plan (1937-1938) it had risen to approximately 603,000. And on the eve of the Patriotic War, in 1941, there were some 800 universities and colleges in the Soviet Union, with a student body of 667,000. Thus, in the course of three Stalin five-year plans, the Soviet Union's college and university student body multiplied almost four times over. It should be added that in 1941 there were also some 12,000 postgraduate students, i.e., future scientists and research workers, enrolled in the different universities, colleges and scientific research organizations.

Simultaneously with the introduction and consolidation of planning, with the process of decentralization, and with the rapid increase in scientific personnel, the country's scientific research network underwent a process of differentiation and clarification of functions. Questions of scientific principle were now concentrated chiefly in the Academies, central, republican, and specialized. The colleges and universities occupied an intermediate position. Dedicated primarily to the work of training scientists, teachers, engineers, they at the same time engaged in research activities, both in the sphere of general theory and along practical lines in the various specialties. Principally, however, the practical, technical solution of the problems brought forward in every field by the development of the national economy was concentrated in the big specialized institutes and in the factory laboratories, which maintain direct contact with industry.

In the summer of 1934, in accordance with a decision of the Council of People's Commissars dated April 25 of the same year, the Academy of Sciences of the U.S.S.R. moved from Leningrad to Moscow. This change in location, after more than two hundred years of work on the banks of the Neva, was fully in line with the momentous changes which had come about in the very nature of the Academy's work. Actually, the Academy now headed a national, state scientific research network, and its activities were closely linked up with the concrete problems facing the Soviet state. The new charter of the Academy of Sciences, confirmed by the government on November 23, 1935, describes the Academy of Sciences of the U.S.S.R. as "the highest scientific institution of the U.S.S.R., uniting in its ranks the country's most outstanding scientists." The fundamental purpose of the Academy is defined in the new charter as: "...universal assistance in the general advance of scientific theory and of the applied sciences in the U.S.S.R., and the study and further development of scientific achievements attained in other countries. The Academy of Sciences regards as its basic task the systematic application of scientific achievements to promote the building of the new,
Particularly striking, in connection with these changes in the nature of the Academy's work since the establishment of Soviet rule, with the close contact established between this work and the requirements and ideology of Socialism and the Soviet state, is the fundamental revision undergone by the social sciences as represented in the Academy, both in content and in trend. In 1936, in view of such revision, the research institutes of the Communist Academy became a part of the Academy of Sciences of the U.S.S.R. The State Academy of the History of the Material Aspects of Civilization has also been taken over by the Academy of Sciences.

As we have noted above, the five-year plans brought a continued growth in the work of the specialized institutes, and a steady increase in their number. Gradually, as the result of protracted and strenuous effort in many fields, a situation was brought about which might be called, figuratively speaking, an uninterrupted front in science and technology. Pre-revolutionary Russian science had every right to pride itself on its individual great names, and on the individual fields of work in which it attained remarkable successes. At the same time, however, there were many branches of science and technology in which old Russia, at times, could not boast a single specialist. In such cases, aid would have to be requested abroad. Thus, Russian technology was in many respects dependent on favours — often anything but disinterested — from other countries.

The establishment of an uninterrupted front in science, the training of young scientists and engineers specializing in every conceivable field, is a labour of extreme difficulty, which only a very few countries have accomplished. The establishment of such an uninterrupted front in the period of the first five-year plans, and the appearance of specialists in almost every field of practical importance, was one of the most outstanding achievements resulting from the planning principle in the development of Soviet science and technology. Its attainment required protracted and highly differentiated training; it required independent effort on the part of scientists and engineers; again, it required close and constant contact with industry, the joint exertions of science and industry to overcome obstacles and difficulties.

An important index of the vigorous growth of Soviet science during the five-year plans was the tremendous progress in the sphere of specialized publications. As yet, unfortunately, there has been no bibliographical survey of our scientific literature and its development since the establishment of Soviet power. Still, a general knowledge of the quality of this literature, and a comparison with developments in other countries during the same period, permit the confident assertion that our attainments in this field are very considerable indeed. Just one example: In tsarist Russia there was only one periodical devoted to original scientific papers in the sphere of physics. This periodical had no more than 200 subscribers. At present, there are five big periodicals devoted to physics, with a circulation of some 5,000 each. The same is true, often in even more astounding measure of other fields of science.

During the pre-war five-year plans, public activity in science was very intense. This period was marked by an endless succession of congresses, conferences, and meetings, in many cases initiated and organized by the Academy of Sciences of the U.S.S.R. In 1940, for example, the Academy of Sciences organized 70 conferences attended by representatives of different scientific institutes and industrial plants. The Academy held special sessions in Sverdlovsk and Novosibirsk on the problem of the Urals and Kuzbas. Another session, held in Leningrad, was devoted to the problem of the Volga and the Caspian. The number of expeditions sent out by the Academy of Sciences and various special organizations increased yearly in every field: flora, fauna, geology, geography, ethnography, archaeology. Again, there were many complex expeditions, as for example the one to Mt. Elbrus, which included representatives of the most varied branches of science, from specialists in the study of cosmic rays to physiologists and physicians.

The tremendous advance of science and technology under the five-year plans, and the uninterrupted front of science which took shape in this period, make it practically impossible to describe, indeed, even to enumerate, in such short space, even the main attainments of Soviet science, as embodied,
on the one hand, in mountains of books, periodicals, patents, and copyrights, and, on the other, in concrete form, in machines, factories, foods, and goods. Hence, the present resume must be limited to a very brief and superficial review of a few particularly outstanding works.

Russian mathematics had occupied a leading position in world science ever since the beginning of the nineteenth century; but never had it attained such scope, such depth, such variety as in the period we are now examining. We must note especially the original works of our mathematicians, and in particular those of Academy member I. M. Vinogradov in the theory of numbers: the development of a new analytical method, and the solution of several extremely difficult problems in this field. Academy members S. N. Bernstein and A. N. Kolmogorov, and corresponding Academy member A. Y. Khinchin, produced works in the theory of probabilities of great importance not only to mathematics, but also to physics, various branches of statistics, technology, and the military sciences. Important progress, of great practical significance, was scored in the theory of differential equations. Of the many brilliant works in this field, we may note those of Academy members I. G. Petrovsky, S. L. Sobolev; and V. I. Smirnov. New and original work was done in geometrical topology by P. S. Alexandrov, a corresponding member of the Academy.

Before the revolution, Russian physics had developed in but few directions. In the new conditions, however, it quickly expanded along a broad and inclusive front. In the U.S.S.R. today the physical sciences are represented by numerous specialists, the authors of important developments both in general theory and in practical technology. Among the most outstanding of these developments in the period under consideration, first mention must be accorded to the remarkable discovery by Academy members L. I. Mandelstam and G. S. Landsberg of a new form of diffraction of light, which has received the name of combination diffraction. Simultaneously with the Soviet scientists (1928), this phenomenon was discovered also by the Indian physicist Raman, in Calcutta. It laid the foundation for a new and very extensive field of science, interesting both physicists and chemists, and opened new possibilities in the study of molecular structure. Soviet researchers also attained momentous results in the study of physical phenomena occurring at temperatures approximating to absolute zero. Thus, Academy member P. L. Kapitsa discovered a new and remarkable property of liquid helium, which has been called "superfluidity." The theoretical elucidation of this astonishing phenomenon was worked out by Academy member L. D. Landau; and the most subtle conclusions to which this theory leads (two sounds in liquid helium) were confirmed experimentally by the young physicist V. P. Peshkov.

Soviet physicists and mathematicians made basic contributions to the study of non-linear oscillations, i.e., oscillations mathematically expressed by non-linear differential equations. The works of Academy members L. I. Mandelstam, N. D. Papalexy, A. A. Andronov, and N. M. Krylov, and of corresponding member N. N. Bogolyubov, led to most important conclusions, both theoretical and practical, in radio and mechanics.

Academy member A. F. Joffe completed a number of important systematic investigations in the physics of semi-conductors, which opened up new prospects in the field of electrotechnical materials, photoelectricity, and the like. After a profound and detailed investigation of interference phenomena, Academy member V. P. Linnik succeeded in working out a large number of ingenious interference instruments, based on new principles, which offer important possibilities in the study of the quality of surfaces, of the precision of mechanical parts an the construction of astronomical instruments, and the like.

Soviet chemistry also developed and expanded under the Stalin five-year plans, and produced a number of works of the greatest moment, both theoretical and practical. Thus, the works of Academy members A. E. Favorsky and S. V. Lebedev paved the way for the establishment of the synthetic rubber industry in the U.S.S.R. The investigations of Academy member A. N. Nesmeyanov threw a new light on the important field of organometallic compounds. Academy members N. D. Zelinsky and A. A. Balandin completed work of some importance, both theoretical and practical, in the field of catalysis. A number of new and important trends developed in Soviet
physical chemistry. In the study of surface-active substances, note should be taken of the numerous systematic investigations of Academy members A. N. Frumkin and P. A. Rebinder. Academy member N. N. Semyonov greatly advanced the study, both theoretical and experimental, of chain reactions and their kinetics. Academy member A. N. Terenin did important experimental work on photochemical reactions. He is the discoverer of the photodissociation of diatomic molecules, and has secured very promising results in the field of complex organic compounds.

The collective style of work which has become a feature of Soviet science generally was particularly notable in the huge geological investigations conducted under the five-year plans. It was these investigations, seeking and discovering oil, metal ores, and other minerals in various parts of the Soviet Union, that charted Soviet industry's raw material base. The labours of Academy members A. D. Arkhangelsky, I. M. Gubkin, S. S. Smirnov, P. I. Stepanov, A. E. Fersman, and V. A. Obruchev, and their numerous pupils and followers, made possible the solution of many problems of the first importance involved in the fulfillment of the five-year plans.

Particularly important among the numerous geographical expeditions and investigations undertaken in this period was the exploration and conquest of the Arctic, marked by such outstanding events as the voyage of the Chelyuskin, the flight to the North Pole headed by Academy member O. J. Schmidt, and the renowned Papanin camp on the drifting ice.

From the very outset, Soviet biology entered the service of agriculture and medicine. Many outstanding achievements of Soviet science in the sphere of plant and animal selection, plant breeding, and phytogeography found immediate application in agriculture. Academy member I. P. Pavlov's investigation of high nervous activity, begun prior to the revolution, was greatly expanded in the new conditions, both in his own work and in that of his pupils, and led to many conclusions of great importance in medicine.

Technology, too, numbers countless achievements for this period. The quality and scope of Soviet technology were well expressed in such gigantic power projects as the hydrotechnical stations on the Svir, the Volkhov, and the Dnieper. Industry — iron and steel, machine-building, electrical, chemical — grew up on the basis of Soviet science, of the tremendous experience gained by our scientists and engineers. Powerful radio stations, a reorganized railway system, the Moscow subway, the huge dams and locks of the Moscow-Volga canal — such are a few examples of the new Soviet technology developed under the five-year plans.

The fundamental revision of the social sciences continued under the five-year plans. This period was marked by practical work on the history of the Soviet Union. The history of literature, both of the Russian people and of other Soviet nationalities, was now approached, for the first time, from the point of view of the new, Soviet principles in the study of literature. Orientalogy, in the multinational Soviet Union, acquired an entirely new trend, being applied to the problem of creating grammars and dictionaries for different Soviet peoples, and of compiling their histories. A new science of law was developed, and intricate problems arising in the new Soviet economics investigated.

All these achievements of Soviet science were facilitated by the exceptional solicitude and attention accorded it by Stalin, and by his views on progressive science, which guided the Academy of Sciences in all its work.

Of tremendous importance in the ideological development of Soviet scientists was Stalin's remarkable work, the History of the C.P.S.U. (B.), Short Course, published in 1938.

In December 1939 the General Assembly of the Academy of Sciences of the U.S.S.R. elected Joseph Vissarionovich Stalin an honorary member of the Academy, for his outstanding services towards the advancement of science and for his continuation and development of the Marxist-Leninist doctrine in every sphere.

This election was a vividly symbolic act, illustrating the transformation which had made the
Academy of Sciences of the U.S.S.R. the true staff of progressive Soviet science.

By 1941, on the eve of the Great Patriotic War, the Soviet Union could boast a huge army of scientists, comprising almost a hundred thousand men and women who had dedicated their lives to scientific labours in the countless new institutes, in the Academies, in the colleges and universities, in industry. The Soviet scientists had created a great new scientific literature, and had organized themselves in a scientific front which was destined to aid the military front in the difficult years of war.

* * *

In launching their campaign against the Soviet Union, the fascists miscalculated on a great number of points. One of these was an underestimation of Soviet science.

The war was a test for Soviet science, a test of redoubled severity. On the one hand, science was called upon to solve entirely new and often extremely intricate problems in every conceivable field, set before it urgently by the front, the war industries, and the national economy as a whole. On the other hand, it was compelled to work in unaccustomed conditions, often involving great hardship.

Many of the Soviet scientists went to the front to defend their country, exchanging books and laboratories for rifles or fighter planes. Many never returned. They gave their lives for their country in the field of battle.

Enemy bombs and shells destroyed the Pulkovo Observatory and the famous conservatories of the Leningrad Botanical Gardens. The astronomical observatory at Simeiz was looted, and destroyed by fire. The German vandals blew up Kiev University and the Byelorussian Academy of Sciences, and plundered the laboratories and libraries of many colleges and universities. The losses of scientific equipment were tremendous.

A large number of scientific institutes were evacuated far to the rear. Here they had to work in unaccustomed conditions, without the proper equipment, instruments, materials, and libraries. In some cases, as for example in Leningrad during the blockade, scientific work was carried on through cold and hunger, punctuated by daily enemy bombardment.

Despite these hardships and privations, Soviet science came through the war with, colours flying. Its response to the wartime requirements was concretely expressed in the form of new and improved types of artillery; in rocket projectiles; in the constant improvement of planes and motors; in the development of new types of armour and of armour-piercing shells to fight the German "Tigers" and "Ferdinands"; in the achievements of Soviet radio; in the faultless service of all types of military optical instruments, and their constant development and improvement; in the splendid organization of the medical service, which saved the lives of hundreds of thousands of wounded soldiers and combated infection and epidemic both at the front and in the rear.

Every new detail of military equipment and materials, every new drug and method of treatment, bore the imprint of scientific thought and labour.

The war industries demanded new and more rapid methods of testing output, new machinery, new materials, new designs; and in almost every case science supplied the need. Agriculture, with almost all the able-bodied men of the countryside off at the front, called for urgent agronomical and agrotechnical assistance, for the development of new methods of work. Here, too, science responded promptly to the call.

The knowledge and experience accumulated in the years preceding the war, the abundance of scientific personnel, and the devoted patriotism of the Soviet scientists helped the country to overcome many difficulties. Nor was Soviet science, in this period, confined entirely to wartime effort — for the front, for industry, for agriculture, for medicine. It also continued its development along fundamental lines. That is clearly to be seen in the long lists of Stalin prizes awarded during the war for outstanding works in science and technology. These remarkable lists record the
momentous scientific achievements of industrial personnel, collective farmers, engineers, and eminent scientists engaged in the study of key problems in the different fields of science. Even in the most trying days of the war, scientific thought worked on.

All the leading scientific periodicals in the Soviet Union continued publication throughout the war, and the majority of the universities and colleges continued to function. Early in 1943, at the time of the decisive fighting at Stalingrad, the Soviet scientists marked the three-hundredth anniversary of the birth of Isaac Newton, the great founder of modern physics. Celebrated with the warmest enthusiasm and interest, this holiday of science, at the very height of the war, at the period of its crisis, was a striking demonstration of the strength and vitality of Soviet science.

Like the period of the Stalin five-year plans, the war was a new school for science. It taught scientists to distinguish even more clearly than before between things of the first and of the second importance, between matters of state and "pure science," so called. The war showed how swiftly and confidently the most difficult of problems can be solved by a collective scientific body inspired by fervent patriotism; it showed what potent scientific forces lay latent in the most far-flung parts of our country.

Early in the war — in the spring of 1942, after the rout of the Hitlerites on the approaches to Moscow — Stalin wrote, in a telegram addressed to the president of the Academy of Sciences:

"I am confident that the Academy of Sciences, despite difficult wartime conditions, will keep pace with the increased requirements of the country."

In a second telegram to the president of the Academy, Stalin wrote:

"I hope that the Academy of Sciences will head the movement of innovators in science and industry, will become the centre for progressive Soviet science in the struggle which has been launched against the most malignant enemy of our people and! of all other freedom-loving peoples — German fascism."

In the Academies, in the specialized institutes, in the colleges and universities, Soviet scientists and engineers strained every effort to justify Stalin's faith in Soviet science, to help the Soviet Army and the Soviet people through the difficult years of war. Despite the difficult and unaccustomed conditions, science kept pace with the country's increased requirements: Soviet men of science were to be found everywhere — in the air force, the navy, the artillery, the engineers, the railway troops, the hospitals, the war plants, the collective farms. And everywhere they offered help and counsel. Soviet science may claim its share in the victory of the Soviet Army.

The two hundred and twentieth anniversary of the foundation of the Academy of Sciences of the U.S.S.R., celebrated in June 1945, when the red Soviet banner of victory was floating, over the Reichstag in Berlin, came as a red-letter day to Soviet scientists, a day for the summation and review of all that Soviet science had accomplished both in time of war and in the entire post-revolutionary period.

After the victory gained in the Great Patriotic War our motherland, and our science, turned to new tasks. Science was called upon to take an active part in the rehabilitation of towns and villages which the enemy had raided, plundered and destroyed, and in the fulfillment of the post-war Stalin five-year plan of reconstruction and development of the national economy. After the military problems of the recent past, science now turned to the manifold problems of socialist construction. The direction and content of all the work of the Academy of Sciences are defined by the tasks which the great Stalin has, set the Academy.

SSoviet science is increasingly well provided for. It enjoys the unfailing support of the Communist Party, the Soviet government, and Stalin personally. An outstanding part in the development of Soviet science has likewise been played by Stalin's closest comrade in arms, Vyacheslav Mikhailovich Molotov.

On November 29, 1946, the Academy of Sciences of the U.S.S.R. elected Vyacheslav Mikhailovich
Molotov an honorary member of the Academy, for his eminent contributions to the development of the Marxist-Leninist science of society, the state and international relations, and for his distinguished services in the building and consolidation of the Soviet state.

Heir to everything worthwhile left us by pre-revolutionary Russia in the field of culture, Soviet science has grown up together with the country. It has come through the early Soviet years, the period of intervention and civil war; it has come through the stern school of the Stalin five-year plans, and been tempered by the heroic days of the Great Patriotic War.

Our science met the thirtieth anniversary of the Great October Revolution as a distinctly Soviet science, differing essentially from the science of other countries. Our science is vigorous, extensive, comprehensive. It keeps pace with every need of the Soviet state and the national economy. That is one of its most striking distinctive features, as compared with the science of old Russia.

And what has science given our country in this period? We need only look about us to see its fruits on every hand. Indeed, the Soviet state as a whole, through all the difficulties of existence in capitalist encirclement, is guided and directed along the lines conceived and expounded by the great scientific doctrine of Marx, Engels, Lenin and Stalin.

Soviet science justly prides itself upon the fact that our people have given the world the genius of Lenin and Stalin, supreme exponents of progressive scientific thought, founders of the Soviet state. Lenin and Stalin have enriched Marxism and greatly advanced it, applying it to the new conditions of development of society. They have revealed the laws of this development in the new age, that of imperialism and socialist revolution. They have created the doctrine of the victory of Socialism, and of the building of Socialism in our country on the foundation of the Soviet system, and they have realized this great teaching in practice.

Our science is based on the brilliant scientific works of Lenin and Stalin — in particular, Lenin's Development of Capitalism in Russia (1899), Materialism and Empirio-Criticism (1908), and State and Revolution (1917), and Stalin's Anarchism or Socialism (1906-07), Marxism and the National Question (1912-13), Foundations of Leninism (1924), and Dialectical and Historical Materialism (1938); it is based on Stalin's program for the socialist industrialization of our country and the collectivization of agriculture, on Stalin's military strategy, on Stalin's teachings concerning the state, cadres, Soviet intellectuals, and progressive science, on the great Stalin Constitution. Such is the indestructible foundation of our science, the bulwark of the sole true philosophy, our guide in scientific labour and in the fight for Communism.

Thanks to the works of Lenin and Stalin, the development of the state, as a social process, is now, for the first time in human history, regulated on the basis of scientific theory. And side by side with this magnificent manifestation of the science of human society in the life of the Soviet state, we observe in every sphere the results of the concrete application of modern science and technology. The simple electric bulb which illumines the expanses of the Soviet land received its present shape as the result of long years of co-operation between science and industry, as the result of manifold assistance from physics, chemistry, the iron and steel industry, the glass industry, and high vacuum technique. Radio, invented half a century ago by A. S. Popov, has developed and expanded as a result of the tireless work of Soviet physicists and engineers. To the Soviet citizen, radio takes the form of super-powerful broadcasting stations and of a tremendous receiving network. It has penetrated to the most distant corners of the country. Radio was a very timely development for the socialist, Soviet land. It has become a powerful means of information and propaganda, a means of uniting the people in labour, struggle, and festivity. Telephones, automobiles of every type, new models of steamers and locomotives, Soviet aircraft, which are undergoing constant modification and improvement — all demonstrate that science and technology have penetrated to the very core of life in our country. Science has in many ways revised the nature of cultivated crops. Thus, it has produced new and improved forms of the cereal crops, adapted to the peculiarities of climate prevailing in different parts of our country. Human lives are preserved by the knowledge and skill of Soviet surgeons and roentgenologists, by Soviet medicines. The clothes we wear, the buildings we
live in, the electricity we use — all this is the result of the application and development of our scientific and technical knowledge. In concentrated form this knowledge is expressed in mountains of books published since the establishment of Soviet rule.

The views of Soviet men and women on nature and society have changed fundamentally. They are now based on wholesome, unconquerable dialectical materialism. Guided by dialectical materialism, the Soviet scientist fearlessly combats every attempt to distort science, every manifestation of the fog of idealism which may appear from time to time in the path of scientific development.

But science cannot stop, cannot rest on its laurels. Science, by its very nature, is variable, dynamic, incapable of marking time. And this dynamic force of Soviet science is embodied in its cadres, in its scores of thousands of specialists, including over ten thousand Doctors of Science and some twenty-five thousand Masters of Science. This huge scientific army which has grown up in the years of Soviet rule will create the future of science, will solve the countless new problems facing the Soviet Union in the post-war period.

The second world war brought humanity concrete proof of the tremendous importance of science and technology in our times. The development of science has put into the hands of the human race weapons and natural forces equivalent in power to elemental upheavals. And it is a matter of the most vital moment into whose hands these mighty weapons fall. Science and technology in the hands of insane fascism threatened the fate of humanity. Science and technology in the hands of imperialists who dream of world dominion become a means of enslaving the peoples. Science and technology in the hands of progressive Soviet democracy promote universal prosperity and facilitate the advance to Communism.

In the early eighteenth century Russian science was helped by renowned foreigners — Euler, Bernoulli, and others. Later in the same century, our country evinced its own power. From the depths of the people, from distant Archangel, Kazan, Tobolsk, Ryazan, came the great Russian scientists: Lomonosov, Lobachevsky, Mendeleyev, Pavlov. These men set the world brilliant examples of creative scientific labour. But only since the establishment of Soviet rule have all the country's latent forces been set in motion, have the great, but isolated scientists of the past given place to a huge army of Soviet scientists. It was upon this army that Stalin called, on February 9, 1946, rapidly to overtake and surpass the achievements of other countries. Much has already been done to facilitate the accomplishment of this task. At the same time, the Party and the government are further increasing their assistance to science in the shape of new buildings, equipment, and improved conditions for research work. The Soviet scientists are backed by great experience in the past, and — what is perhaps of even greater importance — they are confronted with a great and absorbing task: to help their country attain, in the shortest possible time, to that most perfect form of social life — Communism. The first three decades of Soviet rule were a period of continuous growth and development of science. The fourth decade must and shall become a period of gigantic scientific achievement. That is our debt to the Soviet people, to our government and Party, to our great leader and teacher, Stalin.

S.I. Vavilov

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The world exists objectively;

Life, everyday practical activities, convince us that the world exists it is of a material nature objectively, independently of man, of his consciousness, sensations and desires. Science testifies to this by proving that the Earth came into existence long before man or any living organisms, that is to say it existed independently of them. The objective character of the world, i.e., its existence apart from and independently of consciousness, implies that it is of a material nature.

It may be asked: since objective idealists admit that the world exists apart from human consciousness, does it not follow that they recognise the material nature of the world? By no means. It is true that objective, in contrast to subjective, idealists admit that the world exists apart from human consciousness. But they do not acknowledge that it is independent of consciousness; they regard it as a product of consciousness. The recognition of the material nature of the world—its existence apart from and independent of consciousness—is the characteristic feature of materialist theory. This fundamental scientific thesis underlies Lenin's theory of matter.

Lenin's concept of matter

We are surrounded by an infinite number of objects and phenomena. Stones and trees, grains of sand and the sun, animals and automatic lathes, the seas and oceans, the stars and planets, and much more besides—all of this we denote by the single word matter. Perhaps you find it perplexing that a single word can be used to cover such a countless multitude of things and phenomena, so different and remote from one another. A little reflection, however, will make it easier to understand why this is so.

Consider, say, how many flowers there are in the world. They are innumerable; there must be thousands of millions. But we have the one word "flower" and we use it to denote a rose, a tulip, a forget-me-not, a fox-glove, and so on. Let us take a more complicated example. You are sitting in a chair reading a book. You have a pencil in your hand, and pen, ink and paper are beside you. On the table is a lamp and nearby is a bookcase. Can you use a single name to denote the book, pencil, table, etc.? Of course, for they are all things. The word "thing" applies to all of them. In logic it is
called a concept.

How are such concepts formed? Although flowers are all different from one another, they have much in common. It is what they have in common that makes it possible to embrace them all in the general concept "flower". This does not include the features that make one flower different from another, but, on the contrary, just those features which are common to all of them. We set aside or, as it is said, abstract from (as it were "disregard") the features which distinguish one flower from another. Hence such concepts are called abstract.

Thus, concepts reflect the common and essential features belonging to different objects and phenomena independently of the individual peculiarities of each of them.

You will probably have noticed that some concepts embrace a wider circle of objects or phenomena than others. Thus the concept "thing" is much wider than the concept "pen" or "table". The latter are included in the concept "thing".

You may perhaps ask: do there exist concepts that are extremely wide, that have the maximum possible range? They do exist. If a concept embraces all objects and phenomena ranging, say, from a grain of sand to the human brain, it can be said to have the maximum range.

The concept "matter" is of this kind. It follows that "matter" is also a concept, just as much as "flower" or "thing", but a very wide one, the widest possible. It is distinguished from ordinary concepts by expressing the essential and common characteristics not of some one group of things, but of all things and phenomena in the world—of everything around us. Philosophy studies concepts of maximum range. They are called philosophical categories. Matter is a philosophical category.

What then are the common and essential properties, the similarities, characterising all things? First and foremost, they consist in the fact that all things are of a material nature, existing objectively, i.e., apart from and independent of human consciousness. They all have this single foundation.

Is this, however, the sole property common to all objects in the world? It is not. They have yet another important property in common. When, for instance, we wash in hot water we have a sensation of warmth. When we look at the trees in a forest, we sense, we see, various colours—the white trunks of birch trees, the green colour of leaves. Consequently, things, which exist independently of its, possess the property of acting on our sense organs and evoking corresponding sensations.

Now that we have become clear about the most general properties of things and phenomena, we can give a definition of the concept of matter. In his work Materialism and Empirio-Criticism, Lenin wrote: "Matter is a philosophical category denoting the objective reality which is given to man by his sensations .... Matter is that which, acting upon our sense organs, produces sensation; matter is the objective reality given to us in sensation, and so forth." 1

As you see, matter is that which surrounds us, everything that exists objectively—the boundless external and material world, which by acting on our sense organs produces sensations.

From the preceding talk you already know that in antiquity (and also about a hundred years ago) some materialists conceived matter as being a definite "material" of which all things consist. Democritus, for example, regarded atoms as being the primary basis of all matter.

In the 17th and 18th centuries, science regarded atoms as being indivisible, indestructible and eternal. They were the "ultimate bricks" of the universe, the building material of which the whole world was made. This view prevailed in the 19th century as well. But, as already mentioned, at the end of the 19th century discoveries were made which threw doubt on the correctness of such a conception of the primary basis of matter.

What were these discoveries?
Lenin on the revolution in natural science

In 1896 the French physicist Becquerel accidentally left some uranium ore close to a closed packet of photographic film. Some time later he noticed that the film had blackened. He concluded that uranium ore gives out rays, invisible to the eye, that can penetrate cardboard and blacken a photographic film. This began the study of the remarkable phenomena which were named radioactivity.

Before long a new chemical element was discovered and named radium. Later, this "great revolutionary", radium, began to make no small stir in the world.

The rays emitted by radium testified to something that was the direct opposite of what was known about the atom until then. These rays were found to consist of minute particles of three kinds: alpha ($\alpha$)—particles with a positive electric charge, beta ($\beta$)—particles, or electrons, with a negative charge, and gamma ($\gamma$)—rays having no electric charge. The uranium atom had apparently disintegrated into these particles. But for over two thousand years it had been held that the atom was indivisible. Scientists at first suspected a mistake had been made.

But there was no mistake. By the end of the 19th century it was firmly established that the opinion about the indivisibility of the atom had simply to be discarded; the atom was divisible. It disintegrated and at the same time many old notions disintegrated as well.

Other discoveries, too, indicated the collapse of the old notions of matter and its properties. At the beginning of this century, for example, the famous physicist, Albert Einstein, showed that the ideas of space and time that had been held in physics since the time of Galileo and Newton required to be radically altered. Einstein's new ideas were the basis of his theory of relativity.

Since Newton's time scientists had considered that the mass of a body at rest or in motion was constant, unchanging. Modern research, however, showed that the mass of the electron does not remain constant but varies with the velocity of the electron.

Thus, the recent scientific discoveries overthrew the old notions of the indivisibility of the atom, the constancy of mass and the invariability of space and time. There began a revolution in natural science, as Lenin called it.

Bourgeois idealist philosophers were not slow in taking advantage of these discoveries. They argued along the following lines: the indivisible atom which was regarded as the basis of matter is found to divide into fragments. Hence the very foundations of the edifice of materialism and its central element—matter—have collapsed.

Furthermore, mass used to be considered the essential property of all bodies, of matter. But it turns out that the mass of the electron varies with its velocity. Consequently part of its mass has "disappeared". Hence "matter also disappears". These philosophers therefore concluded: materialism is bankrupt. Since this conclusion was made on the basis of the new data of physics, collected at the turn of the century, this trend of idealist philosophy was called "physical idealism", a term introduced by Lenin in his book Materialism and Empirio-Criticism, published in 1909. Lenin crushingly refuted the inventions of the idealists.

The natural-scientific picture of the world

What really happened to science at the turn of the century? New knowledge was obtained. The existence of electrons, protons and the atomic nucleus was previously unknown. All these data showed that our natural-scientific picture of the world, our ideas of the structure of matter, had changed. But did these new data justify the conclusion that electrons, atomic nuclei, etc., were of a non-material nature? Let us see.

Do electrons exist objectively, independently of man, or not? Of course, they do. Lightning, for example, is nothing but a powerful stream of electrons. And we know that lightning occurred before
man existed.

Some idealist philosophers maintain that the electron is of a non-material nature because it does not act on our sense organs, it cannot be seen. But this is not the case. Electrons and other minute atomic particles are studied by means of very delicate instruments. The tracks of their movements can even be photographed. Hence they do act on our sense organs, although this occurs through the medium of special apparatus. Thus, these particles exist objectively and act on our sense organs; hence, they are of a material nature.

Lenin concludes therefore that matter has by no means "disappeared". It is simply our knowledge of it that has altered. It was previously thought that the world consisted of minute particles—atoms. Now we know more, we have deepened our knowledge and discovered that there exist more minute particles—electrons. But the electron is just as inexhaustible as the atom. This means that science will reveal a more and more profound natural-scientific picture of the world, for more and more will become known of the structure, state and properties of the concrete forms of matter.

Lenin's words have been confirmed.

Modern science has made many new discoveries about the structure of matter. At first only the electron and proton were known, but now over 30 different "elementary" particles have been discovered. And so, not only atoms, but electrons and other particles are of a material nature. Materialism has by no means been "overthrown".

Lenin's ideas philosophically substantiated the major scientific thesis that there exist two basic forms of matter—substance and field.

Substance, as understood in modern physics, is a form of matter consisting of particles possessing its own mass (mass at rest). They include the so-called elementary particles.

Field is a material structure connecting bodies with one another and transforming action from one body to another. There is the electromagnetic field (one variety of which is light), the gravitational field, and the nuclear field connecting the particles of the atomic nucleus.

These two forms of matter—substance and field—cannot be divorced from one another. Under certain conditions they are converted into each other. Thus two particles of matter—a pair consisting of an electron and a positron—under definite conditions become converted into a photon—a particle of the electromagnetic field. This implies that one form of matter—substance—has been transformed into another form—light, electromagnetic vibrations, which is the same thing as the electromagnetic field. Thus, no disappearance of mass occurs in nature.

The historic service rendered by Lenin is that by his analysis of the significance of the scientific discoveries he upheld materialism and convincingly showed that metaphysical materialism must not be confused with dialectical materialism. The former holds that matter consists of immutable and indestructible atoms. The starting point of dialectical materialism is that matter cannot be reduced to an "ultimate brick"—the atom; nor can it be reduced to some sort of "eternal" property. Matter possesses not one property, but innumerable properties; just as there is a great diversity of objects in the world, so their properties too are equally diverse. This has been confirmed by scientific discoveries. That is why Lenin wrote: "Modern physics is in travail. It is giving birth to dialectical materialism."2

Lenin showed further that the theory of the structure of matter must not be confused with the philosophical definition of matter as an objective reality. Scientific discoveries decide the question of the structure of matter, whether it consists of atoms or electrons, or whether there are also other particles. Philosophy, however, tackles a different question: whether the world, and hence these particles, exists objectively, apart from human consciousness. Consequently, no matter what new "particles" science discovers (and it is continually discovering new ones) materialism cannot be overthrown, for these particles themselves are of a material nature, existing objectively, independently of man and mankind.
Therefore, the philosophical concept of matter must not be confused with the question of the natural-scientific picture of the world. Our notions of the structure, state and properties of concrete forms of matter—the natural-scientific picture of the world—are continually changing, for scientists acquire ever deeper knowledge of the world and its structure. It follows that the new discoveries have refuted the old knowledge of the natural-scientific picture of the world, but not the philosophical concept of matter, which concerns the objective existence of the world and not its structure. However greatly our ideas of this picture of the world may alter, they cannot testify to the disappearance of matter. As Lenin said, what disappears is the boundary of our knowledge of matter. But the material nature of the world, matter as an objective reality, receives fresh confirmation.

But why is it that idealists so zealously combat the concept of matter?

The theory of matter refutes belief in God

The French Catholic philosopher Alfred Ancel has said that what he dislikes most about Marxism is the dialectical theory of matter". "The Church would not condemn Marxism," he says, "if it did not arbitrarily exclude all intervention of God in the origin and development of the world; if Marxism has to be condemned, it is only on account of its materialism." That, it appears, is the "root of the evil" of Marxist philosophy!

The theory of matter precludes all divine intervention. It makes nonsense of the religious inventions about the creation of the world. All religions are alike in maintaining that God created the world "out of nothing". Science, however, has firmly established that in nature nothing arises out of nothing and nothing disappears without a trace. In science this finds expression in a special law, the law of the conservation of mass or, in other words, the law of the conservation of matter. The only possible conclusion is that drawn by materialism: matter never came into existence, it has always existed and will always exist. The world is eternal, it was not created by anybody. The scientific thesis of the eternity of matter radically undermines religious belief in the creation of the world.

This thesis of the eternity of matter often evokes questions from students of Marxist philosophy. They ask: "How is it possible that matter has always existed? Must it not have come into being at some time?" There is nothing surprising about these questions. In his lifetime a person comes to see that everything has a beginning and end. That is why he asks: who created matter? Science answers: it has always existed.

As far back as Greek antiquity, Heraclitus wrote that the world was not created by any God nor any man, but was, is, and will be eternal.

What proof is there of this important conclusion?

There are very many facts in favour of it. Take, for example, the law of the conservation of matter.

Let us begin with a domestic example. You burn firewood in a stove. At first sight it seems to have disappeared, leaving only a little ash. But careful weighing of the products of combustion shows that there has been a gain, not a loss in weight. For they contain the same substances that were in the wood before it was burnt and in addition those taken from the air during burning.

The great Russian scientist Lomonosov drew attention to such a fact. He concluded that no body or element could be annihilated nor could it arise out of nothing. He formulated this idea in the law of conservation of matter.

It follows from this most important law of nature, that the religious myth of God's creation of the world out of nothing is entirely fallacious. If we assume there was a time when there was nothing in the universe, i.e., there was no matter, there was nothing from which it could arise. But since matter exists it means that it never came into existence but has always existed and will exist. It is eternal and immortal. The scientific thesis of the eternity of matter radically undermines the religious faith in the creation of the world.
Furthermore; since matter is the basis and source of all the phenomena of nature, there cannot be any such phenomenon not existing objectively and really, and not susceptible of being studied by the sense organs, physical apparatus or other scientific means. That being the case, there is no room for religious tales about angels or spirits, no room for divine Providence.

If, indeed, angels do exist, why do they not manifest themselves in any way? Even the very minute electrons have become available for man's study. Why are angels not detectable whether by our sense organs, physical apparatus or anything else? Nor is the effect of their "actions" observable. Is there anything in the world of which it can be said: this was the work of angels? There is not. Consequently, neither God, nor angels, nor the "other world", exist. The Church is unable to refute this conclusion. That is why the materialist concept of matter is so hateful to the idealists and the Church. That is why they try to refute it by saying that "matter has disappeared". Since they cannot succeed in that, they try at least to distort the true meaning of the concept of matter.

They assert: suppose matter has existed eternally, materialism will gain nothing from that. Let us imagine, they say, the infinitely remote epoch when instead of the present universe there existed some kind of formless, motionless matter. It remained in that state for an infinitely long time. But a time came when matter had to emerge from the state in which it had been until then. But if it had been motionless until then, how did it suddenly come into motion? Within matter itself, say the idealists and the Church, there cannot be any basis for such a change. Consequently, there must be some power, outside and apart from nature or matter, which brought this dead matter out of its state of "dormancy" and immobility. This power is God.

But does matter really require some higher power to give it this impulse?

**Matter exists in motion**

Ask someone who has not studied Marxist philosophy what motion is, and you will probably be given something like the following answer: "Motion is change of place. If an object remains in one place, it does not move. A stone, for instance, does not change its position unless someone throws it." But take a look at the stone at rest. Motion is, nevertheless, taking place within it: the atoms, molecules, electrons and protons, which we know to be present in all bodies, are in continuous motion. A house, too, is not motionless, it moves together with the Earth around the Sun. Suppose that we are seated at a meeting and must not move. Our blood, however, is circulating, and complex motions are taking place in our body: new cells are being formed and old ones dying or being destroyed. This is also motion. It follows that the problem of motion is much more complicated than is sometimes thought.

People see that a stone lies where it is until it is thrown, and that a motor-car does not move until the chauffeur drives it. It is roughly on arguments of this kind that the Church bases its opinion that matter was in a motionless state until a higher power, God, communicated the "first impulse". Even such an eminent scientist as Newton could not explain the motion of matter from matter itself. He considered that God imparted the "first impulse" to nature, that God "wound the clock" and only after this did motion become an inherent characteristic of matter. But is such a dead, motionless state of matter possible? In other words: was there a time when matter but not motion existed?

About two hundred years ago science had investigated only one form of motion-displacement in space. At that time it was possible to assume that a body would remain at rest until some external force brought it out of this state. This view was then applied to nature as a whole. But the development of physics, chemistry and biology showed that motion occurs in various forms.

Take, for example, heat. It turned out that this was the result of the motion of a vast number of molecules, as in the case of water. Water becomes hot owing to the motion of the molecules. This is not mechanical motion, but something new and more complex. An electric current is a flow of electrons. And a chemical reaction is motion, combination of ions, a still more complex process. A living organism, too, as already mentioned, is always in a state of motion. Incessant processes take
place in human society: the social order changes, people themselves change.

What conclusion should be drawn from all this? It is that various forms of motion exist in nature. There is, firstly, displacement in space of particles of matter or bodies, i.e., the mechanical form of motion. Secondly, heat and electrical processes, or the physical form of motion. Thirdly, chemical reactions, the combination of ions, the chemical form of motion. Fourthly, changes occurring in living organisms, or the biological form of motion. Fifthly, the social form of motion, i.e., changes taking place in social life.

It cannot be said, therefore, that motion is simply displacement of bodies in space, for this is only one form of motion. What we have been considering is the question of what motion is in the most general, philosophical sense of the word. This implies primarily determining what is the chief, characteristic feature of all forms of motion. Motion, Engels wrote, "comprehends all changes and processes occurring in the universe, from mere change of place right up to thinking". It follows that motion comprises all changes taking place in objects or phenomena, that is to say, in the world, in matter. It is change in general.

Is it possible for matter to be in a state in which no changes take place in it? Of course not. Even in the remote past when there were no people, no animals, no living cells, matter underwent changes. Bodies consist of molecules and atoms and the latter are in constant motion. Hence, there never was any ossified, absolutely motionless body. Furthermore, if there were atoms, molecules and electrons, there could not fail to be chemical reactions. Hence, there was also the chemical motion of matter.

It is easy to see, therefore, that matter never was in a state in which it existed without motion. Hence, we say motion is a form of the existence, of the being, of matter. Motion is an inseparable property of matter or, as philosophers put it, an attribute of matter. There is no matter without motion, it exists only in motion.

This conclusion is confirmed by the irrefutable evidence of our practical experience. When a mechanical lathe is in operation, its parts become hot. This means that the mechanical form of motion (the rotation of individual parts) is converted into the heat form of motion. In an engine one can observe the reverse process; steam produced by combustion is used to move the wheels. Here heat energy is converted into mechanical energy.

By generalising such facts, science reached the conclusion that motion cannot be created out of "nothing", nor can it disappear into nothing. Motion can only be transformed from one into another form. This important proposition of natural science was called the law of the conservation and transformation of energy (energy in physics is a measure of the motion of matter).

If at some time matter had been in a motionless state, motion would not have arisen in it. Hence, motion is always inherent in matter, and the latter has no need of any "first impulse". There was never such an "impulse".

This does not mean that dialectical materialism denies the existence of rest. Rest exists in nature, but it is relative. This means that there is no phenomenon in which everything is at rest, in which there is no motion. This was shown above.

If a body is at rest it is so relatively to something. During a journey by car, for example, we are at rest relative to the moving car. But this is not absolute rest, for continual changes are taking place in our body.

The dialectical conception of rest is radically different from the metaphysical conception. Metaphysics conceives rest as the absence of all motion. Dialectical materialism is opposed to this conception.

What is of decisive importance in nature is not rest, although it does exist, but movement, development, change.
Notes


J. V. Stalin

On the Grain Front

From a Talk to Students of the Institute of Red Professors, the Communist Academy and the Sverdlov University
May 28, 1928

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Publisher's Note
The present English edition of J. V. Stalin's Problems of Leninism corresponds to the eleventh Russian edition of 1952. The English translation up to page 766 (including the relevant notes at the end of the book) is taken from Stalin's Works, Foreign Languages Publishing House, Moscow, 1953-55, Vol. 6 and Vols. 8-13, while the rest is taken from the same publishers' 1953 edition of Problems of Leninism. Minor changes have been made in the translation and the notes.

ON THE GRAIN FRONT

Question: What should be considered as the basic cause of our difficulties in the matter of the grain supply? What is the way out of these difficulties? What, in connection with these difficulties, are the conclusions that must be drawn as regards the rate of development of our industry, particularly from the point of view of the relation between the light and heavy industries?

Answer: At first sight it may appear that our grain difficulties are an accident, the result merely of faulty planning, the result merely of a number of mistakes committed in the sphere of economic co-ordination.

But it may appear so only at first sight. Actually the causes of the difficulties lie much deeper. That faulty planning and mistakes in economic co-ordination have played a considerable part—of that there cannot be any doubt. But to attribute everything to faulty planning and chance mistakes would be a gross error. It would be an error to belittle the role and importance of planning. But it would be a still greater error to exaggerate the part played by the planning principle, in the belief that we have already reached a stage of development when it is possible to plan and regulate everything.

It must not be forgotten that in addition to elements which lend themselves to our planning activities there are also other elements in our national economy which do not as yet lend themselves to planning; and that, lastly, there are classes hostile to us which cannot be overcome simply by the planning of the State Planning Commission.

That is why I think that we must not reduce everything to a mere accident, to mistakes in planning, etc.
And so, what is the basis of our difficulties on the grain front?

The basis of our grain difficulties lies in the fact that the increase in the production of marketable grain is not keeping pace with the increase in the demand for grain.

Industry is growing. The number of workers is growing. Towns are growing. And, lastly, the areas producing industrial crops (cotton, flax, sugar beet, etc.) are growing, creating a demand for grain. All this leads to a rapid increase in the demand for grain—grain available for the market. But the production of marketable grain is increasing at a disastrously slow rate.

It cannot be said that the grain stocks at the disposal of the state have been smaller this year than last, or the year before. On the contrary, we have had far more grain in the hands of the state this year than in previous years. Nevertheless, we are faced with difficulties as regards the grain supply.

Here are a few figures. In 1925-26 we managed to procure 434 million poods of grain by April 1. Of this amount, 123 million poods were exported. Thus, there remained in the country 311 million poods of the grain procured. In 1926-27 we had procured 596 million poods of grain by April 1. Of this amount, 153 million poods were exported. There remained in the country 443 million poods. In 1927-28 we had procured 576 million poods of grain by April 1. Of this amount, 27 million poods were exported. There remained in the country 549 million poods.

In other words, this year, by April 1, the grain supplies available to meet the requirements of the country amounted to 100 million poods more than last year, and 230 million poods more than the year before last. Nevertheless, we are experiencing difficulties on the grain front this year.

I have already said in one of my reports that the capitalist elements in the countryside, and primarily the kulaks, took advantage of these difficulties in order to disrupt Soviet economic policy. You know that the Soviet government adopted a number of measures aimed at putting a stop to the anti-Soviet action of the kulaks. I shall not therefore dwell on this matter here. In the present case it is another question that interests me. I have in mind the reasons for the slow increase in the production of marketable grain, the question why the increase in the production of marketable grain in our country is slower than the increase in the demand for grain, in spite of the fact that our crop area and the gross production of grain have already reached the pre-war level.

Indeed, is it not a fact that our grain crop area has already reached the pre-war mark? Yes, it is a fact. Is it not a fact that already last year the gross production of grain was equal to the pre-war output, i.e., 5,000 million poods? Yes, it is a fact. How, then, is it to be explained that, in spite of these circumstances, the amount of marketable grain we are producing is only one half, and the amount we are exporting is only about one-twentieth, of the pre-war figure?

The reason is primarily and chiefly the change in the structure of our agriculture brought about by the October Revolution, the passing from large-scale landlord and large-scale kulak farming, which provided the largest amount of marketable grain, to small- and middle-peasant farming, which provides the smallest amount of marketable grain. The mere fact that before the war there were 15-16 million individual peasant farms, whereas at present there are 24-25 million peasant farms, shows that now the basis of our agriculture is essentially small-peasant farming, which provides the least amount of marketable grain.

The strength of large-scale farming, irrespective of whether it is landlord, kulak or collective farming, lies in the fact that large farms are able to employ machines, scientific methods, fertilizers, to increase the productivity of labour, and thus to produce the maximum quantity of marketable grain. On the other hand, the weakness of small-peasant farming lies in the fact that it lacks, or almost lacks, these opportunities, and as a result it is semi-consuming farming, yielding little marketable grain.

Take, for instance, the collective farms and the state farms. They market 47.2 per cent of their gross output of grain. In other words, they yield relatively more marketable grain than did landlord farming in pre-war days. But what about the small- and middle-peasant farms? They market only
11.2 per cent of their total output of grain. The difference, as you see, is quite striking.

Here are a few figures illustrating the structure of grain production in the past, in the pre-war period, and at present, in the post-October period. These figures were supplied by Comrade Nemchinov, a member of the Collegium of the Central Statistical Board. It is not claimed that these figures are exact, as Comrade Nemchinov explains in his memorandum; they permit of only approximate calculations. But they are quite adequate to enable us to understand the difference between the pre-war period and the post-October period as regards the structure of grain production in general, and the production of marketable grain in particular.

<table>
<thead>
<tr>
<th></th>
<th>Gross Grain Production</th>
<th>Marketable Grain (i.e., not consumed in the countryside)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Millions of poods</td>
<td>Per cent</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Millions of poods</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Per cent</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Percentage of marketable grain</td>
</tr>
<tr>
<td><strong>Pre-war</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Landlords</td>
<td>600</td>
<td>12.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>281.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>21.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>47.0</td>
</tr>
<tr>
<td>Kulaks</td>
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<td>38.0</td>
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<tr>
<td></td>
<td></td>
<td>650.0</td>
</tr>
<tr>
<td></td>
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<td>50.0</td>
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<tr>
<td></td>
<td></td>
<td>34.0</td>
</tr>
<tr>
<td>Middle and poor</td>
<td>2,500</td>
<td>50.0</td>
</tr>
<tr>
<td>peasants</td>
<td></td>
<td>369.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>28.4</td>
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<td></td>
<td></td>
<td>14.7</td>
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<tr>
<td><strong>Total</strong></td>
<td>5,000</td>
<td>100.0</td>
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<td></td>
<td></td>
<td>1,300.6</td>
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<td>100.0</td>
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<td></td>
<td></td>
<td>26.0</td>
</tr>
<tr>
<td><strong>Post-war (1926-27)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>State farms and</td>
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<td>1.7</td>
</tr>
<tr>
<td>collective farms</td>
<td></td>
<td>37.8</td>
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<td></td>
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<td>6.0</td>
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<tr>
<td></td>
<td></td>
<td>47.2</td>
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<tr>
<td>Kulaks</td>
<td>617.0</td>
<td>13.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>126.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20.0</td>
</tr>
<tr>
<td>Middle and poor</td>
<td>4,052.0</td>
<td>85.3</td>
</tr>
<tr>
<td>peasants</td>
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<td>466.2</td>
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<td></td>
<td></td>
<td>74.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>11.</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>4,749.0</td>
<td>100.0</td>
</tr>
<tr>
<td></td>
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<td>630.0</td>
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<td></td>
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<td>100.0</td>
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<td></td>
<td></td>
<td>13.3</td>
</tr>
</tbody>
</table>

What does this table show?

It shows, firstly, that the production of the overwhelming proportion of grain products has passed from the landlords and kulaks to the small and middle peasants. This means that the small and middle peasants, having completely emancipated themselves from the yoke of the landlords, and having, in the main, broken the strength of the kulaks, have thereby been enabled considerably to improve their material conditions. That is the result of the October Revolution. Here we see the effect, primarily, of the decisive gain which accrued to the main mass of the peasantry as a result of the October Revolution.

It shows, secondly, that in our country the principal holders of marketable grain are the small and, primarily, the middle peasants. This means that not only as regards gross production of grain, but also as regards the production of marketable grain, the U.S.S.R. has become, as a result of the October Revolution, a land of small-peasant farming, and the middle peasant has become the "central figure" in agriculture.

It shows, thirdly, that the abolition of landlord (large-scale) farming, the reduction of kulak (large-scale) farming to less than one-third, and the passing to small-peasant farming with only 11 per cent of its output marketed, in the absence, in the sphere of grain production, of any more or less developed large-scale socially-conducted farming (collective farms and state farms), were bound to
lead, and in fact have led, to a sharp reduction in the production of marketable grain as compared with pre-war times. It is a fact that the amount of marketable grain in our country is now half what it was before the war, although the gross output of grain has reached the pre-war level.

That is the basis of our difficulties on the grain front.

That is why our difficulties in the sphere of grain procurements must not be regarded as a mere accident.

No doubt the situation has been aggravated to some extent by the fact that our trading organizations took upon themselves the unnecessary task of supplying grain to a number of small and middle-sized towns, and this was bound to reduce to a certain extent the state's grain reserves. But there are no grounds whatever for doubting that the basis of our difficulties on the grain front lies not in this particular circumstance, but in the slow development of the output of our agriculture for the market, accompanied by a rapid increase in the demand for marketable grain.

What is the way out of this situation?

Some people see the way out of this situation in a return to kulak farming, in the development and extension of kulak farming. These people dare not speak of a return to landlord farming, for they realize, evidently, that such talk is dangerous in our times. All the more eagerly, however, do they speak of the necessity of the utmost development of kulak farming in the interests of—the Soviet regime. These people think that the Soviet regime can rely simultaneously on two opposite classes—the class of the kulaks, whose economic principle is the exploitation of the working class, and the class of the workers, whose economic principle is the abolition of all exploitation. A trick worthy of reactionaries.

There is no need to prove that these reactionary "plans" have nothing in common with the interests of the working class, with the principles of Marxism, with the tasks of Leninism. Talk about the kulak being "no worse" than the urban capitalist, about the kulak being no more dangerous than the urban Nepman, and therefore, about there being no reason to "fear" the kulaks now—such talk is sheer liberal chatter which lulls the vigilance of the working class and of the main mass of the peasantry. It must not be forgotten that in industry we can oppose to the small urban capitalist our large-scale socialist industry, which produces nine-tenths of the total output of manufactured goods, whereas in the countryside we can oppose to large-scale kulak farming only the still weak collective farms and state farms, which produce but one-eighth of the amount of grain produced by the kulak farms. To fail to understand the significance of large-scale kulak farming in the countryside, to fail to understand that the relative importance of the kulaks in the countryside is a hundred times greater than that of the small capitalists in urban industry, is to lose one's senses, to break with Leninism, to desert to the side of the enemies of the working class.

What, then, is the way out of the situation?

1) The way out lies, above all, in passing from small, backward and scattered peasant farms to united, large socially-conducted farms, equipped with machinery, armed with scientific knowledge and capable of producing the maximum amount of marketable grain. The way out lies in the transition from individual peasant farming to collective, socially-conducted economy in agriculture.

Lenin called on the Party to organize collective farms from the very first days of the October Revolution. From that time onwards the propaganda of the idea of collective farming has not ceased in our Party. However, it is only recently that the call for the formation of collective farms has met with a mass response. This is to be explained primarily by the fact that the widespread development of a co-operative communal life in the countryside paved the way for a radical change in the attitude of the peasants in favour of collective farms, while the existence of a number of collective farms already harvesting from 150 to 200 poods per dessiatin, of which from 30 to 40 per cent represents a marketable surplus, is strongly attracting the poor peasants and the lower strata of the middle peasants towards the collective farms.
Of no little importance in this connection is also the fact that only recently has it become possible for the state to lend substantial financial assistance to the collective-farm movement. We know that this year the state has granted twice the amount of money it did last year in aid of the collective farms (more than 60 million rubles). The Fifteenth Party Congress was absolutely right in stating that the conditions have already ripened for a mass collective-farm movement and that the stimulation of the collective-farm movement is one of the most important means of increasing the proportion of marketable grain in the country's grain production.

According to the data of the Central Statistical Board, the gross production of grain by the collective farms in 1927 amounted to no less than 55 million poods, with an average marketable surplus of 30 per cent. The widespread movement at the beginning of this year for the formation of new collective farms and for the expansion of the old ones should considerably increase the grain output of the collective farms by the end of the year. The task is to maintain the present rate of development of the collective-farm movement, to enlarge the collective farms, to get rid of sham collective farms, replacing them by genuine ones, and to establish a system whereby the collective farms will deliver to the state and co-operative organizations the whole of their marketable grain under penalty of being deprived of state subsidies and credits. I think that, if these conditions are adhered to, within three or four years we shall be able to obtain from the collective farms as much as 100 million poods of marketable grain.

The collective-farm movement is sometimes contrasted with the co-operative movement, apparently on the assumption that collective farms are one thing, and co-operatives another. That, of course, is wrong. Some even go so far as to contrast collective farms with Lenin's co-operative plan. Needless to say, such contrasting has nothing in common with the truth. In actual fact, the collective farms are a form of co-operatives, the most striking form of producers' co-operatives. There are marketing co-operatives, there are supply co-operatives, and there are also producers' co-operatives. The collective farms are an inseparable and integral part of the co-operative movement in general, and of Lenin's co-operative plan in particular. To carry out Lenin's co-operative plan means to raise the peasantry from the level of marketing and supply co-operatives to the level of producers' co-operatives, of collective-farm co-operatives, so to speak. This, by the way, explains why our collective farms began to arise and develop only as a result of the development and consolidation of the marketing and supply co-operatives.

2) The way out lies, secondly, in expanding and strengthening the old state farms, and in organizing and developing new, large ones. According to the data of the Central Statistical Board, the gross production of grain in the existing state farms amounted in 1927 to no less than 45 million poods with a marketable surplus of 65 per cent. There is no doubt that, given a certain amount of state support, the state farms could considerably increase the production of grain.

But the task does not end there. There is a decision of the Soviet government on the strength of which new large state farms (from 10,000 to 30,000 dessiatins each) are being organized in districts where there are no peasant holdings; and in five or six years these state farms should yield about 100 million poods of marketable grain. The organization of these state farms has already begun. The task is to put this decision of the Soviet government into effect at all costs. I think that, provided these tasks are fulfilled, within three or four years we shall be able to obtain from the old and new state farms about 80-100 million poods of grain for the market.

3) Finally, the way out lies in systematically increasing the yield of the small and middle individual peasant farms. We cannot and should not lend any support to the individual large kulak farms. But we can and should assist the small and middle individual peasant farms, helping them to increase their crop yields and drawing them into the channel of co-operative organization. This is an old task; it was proclaimed with particular emphasis as early as 1921 when the tax in kind was substituted for the surplus-appropriation system. This task was reaffirmed by our Party at its Fourteenth [1] and Fifteenth Congresses. The importance of this task is now emphasized by the difficulties on the grain front. That is why this task must be fulfilled with the same persistence as
the first two tasks will be, those concerning the collective farms and the state farms. All the data show that the yield of peasant farms can be increased by some 15 to 20 per cent in the course of a few years. At present no less than 5 million wooden ploughs are in use in our country. Their replacement by modern ploughs alone would result in a very considerable increase in grain production in the country. This is apart from supplying the peasant farms with a certain minimum of fertilizers, selected seed, small machines, etc. The contract system, the system of signing contracts with whole villages for supplying them with seed, etc., on condition that in return they unfailingly deliver a certain quantity of grain products—this system is the best method of raising the yield of peasant farms and of drawing the peasants into the co-operatives. I think that if we work persistently in this direction we can, within three or four years, obtain additionally from the small and middle individual peasant farms not less than 100 million poods of marketable grain.

Thus, if all these tasks are fulfilled, the state can in three or four years' time have at its disposal 250-300 million additional poods of marketable grain—a supply more or less sufficient to enable us to manoeuvre properly within the country as well as abroad.

Such, in the main, are the measures which must be taken in order to solve the difficulties on the grain front.

Our task at present is to combine these basic measures with current measures to improve planning in the sphere of supplying the countryside with goods, relieving our trading organizations of the duty of supplying grain to a number of small and middle-sized towns.

Should not, in addition to these measures, a number of other measures be adopted—measures, say, to reduce the rate of development of our industry, the growth of which is causing a considerable increase in the demand for grain, which at present is outstripping the increase in the production of marketable grain? No, not under any circumstances! To reduce the rate of development of industry would mean to weaken the working class; for every step forward in the development of industry, every new factory, every new works, is, as Lenin expressed it, "a new stronghold" of the working class, one which strengthens the latter's position in the fight against the petty-bourgeois elemental forces, in the fight against the capitalist elements in our economy. On the contrary, we must maintain the present rate of development of industry; we must at the first opportunity speed it up in order to pour goods into the rural areas and obtain more grain from them, in order to supply agriculture, and primarily the collective farms and state farms, with machines, in order to industrialize agriculture and to increase the proportion of its output for the market.

Should we, perhaps, for the sake of greater "caution," retard the development of heavy industry so as to make light industry, which produces chiefly for the peasant market, the basis of our industry? Not under any circumstances! That would be suicidal; it would undermine our whole industry, including light industry. It would mean abandoning the slogan of industrializing our country, it would mean transforming our country into an appendage of the world capitalist system of economy.

In this respect we proceed from the well-known guiding principles which Lenin set forth at the Fourth Congress of the Comintern\[2\] and which are absolutely binding for the whole of our Party. Here is what Lenin said on this subject at the Fourth Congress of the Comintern:

"The salvation of Russia lies not only in a good harvest on the peasant farms—that is not enough; and not only in the good condition of light industry, which provides the peasantry with consumer goods—that, too, is not enough; we also need heavy industry."

Or again:

"We are exercising economy in all things, even in schools. This must be so, because we know that unless we save heavy industry, unless we restore it, we shall not be able to build up any industry; and without it we shall be doomed altogether as an independent country." (Vol. XXVII, p. 349.)

These directives given by Lenin must never be forgotten.
How will the measures proposed affect the alliance between the workers and the peasants? I think that these measures can only help to strengthen the alliance between the workers and the peasants.

Indeed, if the collective farms and the state farms develop at increased speed; if, as a result of direct assistance given to the small and middle peasants, the yield of their farms increases and the cooperatives embrace wider and wider masses of the peasantry; if the state obtains the hundreds of millions of poods of additional marketable grain required for manoeuvring; if, as a result of these and similar measures, the kulaks are curbed and gradually overcome—is it not clear that the contradictions between the working class and the peasantry within the alliance of the workers and peasants will thereby be smoothed out more and more; that the need for emergency measures in the procurement of grain will disappear; that wide masses of the peasantry will turn more and more to collective forms of farming, and that the fight to overcome the capitalist elements in the countryside will assume an increasingly mass and organized character?

Is it not clear that the cause of the alliance between the workers and the peasants can only benefit by such measures?

It must only be borne in mind that the alliance of the workers and peasants under the conditions of the dictatorship of the proletariat should not be viewed as an ordinary alliance. It is a special form of class alliance between the working class and the labouring masses of the peasantry, which sets itself the object: a) of strengthening the position of the working class; b) of ensuring the leading role of the working class within this alliance; c) of abolishing classes and class society. Any other conception of the alliance of the workers and peasants is opportunism, Menshevism, S.-R.-ism—anything you like, but not Marxism, not Leninism.

How can the idea of the alliance of the workers and peasants be reconciled with Lenin's well-known thesis that the peasantry is "the last capitalist class"? Is there not a contradiction here? The contradiction is only an apparent, a seeming one. Actually there is no contradiction here at all. In that same speech at the Third Congress of the Comintern[3] in which Lenin characterized the peasantry as "the last capitalist class," he again and again substantiates the need for an alliance between the workers and the peasants, declaring that "the supreme principle of the dictatorship is the maintenance of the alliance of the proletariat and the peasantry in order that the proletariat may retain its leading role and state power." It is clear that Lenin, at any rate, saw no contradiction in this.

How are we to understand Lenin's thesis that the peasantry is "the last capitalist class"? Does it mean that the peasantry consists of capitalists? No, it does not.

It means, firstly, that the individual peasantry is a special class, which bases its economy on the private ownership of the instruments and means of production and which, for that reason, differs from the class of proletarians, who base their economy on collective ownership of the instruments and means of production.

It means, secondly, that the individual peasantry is a class which produces from its midst, engenders and nourishes, capitalists, kulaks and all kinds of exploiters in general.

Is not this circumstance an insuperable obstacle to the organization of an alliance of the workers and peasants? No, it is not. The alliance of the proletariat with the peasantry under the conditions of the dictatorship of the proletariat should not be regarded as an alliance with the whole of the peasantry. The alliance of the proletariat with the peasantry is an alliance of the working class with the labouring masses of the peasantry. Such an alliance cannot be effected without a struggle against the capitalist elements of the peasantry, against the kulaks. Such an alliance cannot be a stable one unless the poor peasants are organized as the bulwark of the working class in the countryside. That is why the alliance between the workers and the peasants under the present conditions of the dictatorship of the proletariat can be effected only in accordance with Lenin's well-known slogan: Rely on the poor peasant, build a stable alliance with the middle peasant, never for a moment cease fighting against the kulaks. For only by applying this slogan can the main mass of the peasantry be
drawn into the channel of socialist construction.
You see, therefore, that the contradiction between Lenin's two formulas is only an imaginary, a seeming contradiction. Actually, there is no contradiction between them at all.

Footnotes
[1] The Fourteenth Congress of the C.P.S.U.(B.) was held in Moscow, December 18-31, 1925. Stalin delivered the political report of the Central Committee. The congress put as the central task of the Party the struggle for the socialist industrialization of the country, as being the basis for building socialism in the U.S.S.R. In its resolutions, the congress stressed the importance of further strengthening the alliance between the working class and the middle peasants, while relying on the poor peasants, in the struggle against the kulaks. The congress pointed to the necessity of supporting and furthering the development of agriculture by means of more efficient farming methods and drawing an ever greater number of the peasant farms, through the co-operatives, into the channel of socialist construction. (For the resolutions and decisions of the congress, see Resolutions and Decisions of C.P.S.U. Congresses, Conferences and Central Committee Plenums, in Russian, 1953, Part II, pp. 73-137. For the Fourteenth Congress, see History of the C.P.S.U.(B.), Short Course, FLPH, Moscow, 1954, pp. 428-33.)


Question One. My evaluation of the present state of science in the Western countries and in the U.S.S.R. is as follows: The economic crisis that has spread all over the Western countries and has shaken the entire basis of capitalism could not but affect the field of the natural sciences as well. If in the Western countries during the period preceding the crisis very little was done as concerns the production of new improved fruit-plant varieties, all the more now, under the conditions of the most severe crisis, no work whatever is to be expected in that direction.

Both in the foreign press and in our Soviet press, my work has been frequently compared with that of the American fruit grower Luther Burbank. I consider this comparison a wrong one. My methods of work are different from those of Burbank, as it was already pointed out long before the Revolution by those American professors who used to visit my nursery systematically every year. The same is also true as regards the organization of work of other private workers in this field in Western countries as well as of the state experiment stations, among which hardly any can he found that would work exclusively on originating new improved fruit-plant varieties.

On examining catalogues of horticultural plants either of the American or of the West-European fruit-trade firms it can be seen that over a period of several decades there were hardly ten new varieties accepted for sale. The question arises, where are those many thousands of new varieties claimed to have been originated both by Burbank and by all the other foreign fruit-plant breeders, about whose work so much and so frequently has been written in the foreign press and in our Soviet press as well? Apparently much of what has been described either existed only in the authors' imagination or proved to he unsuitable for practical purposes. This is only to be expected because the conditions of life under the capitalist system weigh upon the actions of workers in every field in the Western countries. Almost any activity in those conditions is confined to making profit; moreover, a small group belonging to the ruling class appropriates almost all the products of the labour of the working masses.

An entirely different state of affairs is to be found in the U.S.S.R. under the Soviet Government, after the beneficial abolition of classes. Here in the U.S.S.R. everything is based on the aspiration to increase by all means the prosperity of the working people. Thus, in our country such great attention has been drawn to the development of fruit growing that in the nearest future vast territories of our Union will be occupied by wide uninterrupted stretches of orchards-fields each having a total area of several thousand hectares. This unprecedented impetus towards the development of fruit growing in the U.S.S.R. could be brought about only by the October Revolution that released the hitherto fettered productive potencies of the earth and gave the power to the proletariat--the most progressive class of the socialist society.

How magnificent and alluring are the prospects of development of scientific research in the U.S.S.R. can be illustrated sufficiently well by just one typical fact: before the Revolution I worked all alone without receiving a single kopek for the development of my enterprise from the autocratic tsarist government, while at present a number of institutions have been established on the basis of
the results of my fifty-nine years' work. These are the plant-breeding and genetic research station
named after me, a horticultural college, a research institute, a school for fruit growing and a state
orchard farm of five thousand hectares.

Owing to the generous help of the Soviet Government the very pace at which my work progresses
has changed so profoundly that during the single year of 1932 I succeeded in performing the same
amount of work as during the whole of the preceding decade.

After the Second Five-Year Plan is fulfilled the tempo of work on improving fruit-plant varieties
and on producing new varieties will be still further accelerated. In addition to all that, I should like
to call attention to the fact that the unexpected occurrence of new elements in the chemical
composition of the flesh of certain hybrid apples--elements that are normally never present in the
flesh of the different pure apple species--makes it possible to presume that in the course of the
future large-scale hybridization work, such varieties will be obtained the fruits of which will prove
to be useful in curing certain human diseases.

**Question Two.** My views on the interrelations between natural science as a whole and my specific
branch of it on the one hand and philosophy on the other hand are as follows.

Science, and its concrete branch--natural science--in particular, is inseverably bound up with
philosophy; but since man's world outlook manifests itself in philosophy, the latter is, therefore, a
weapon in the class struggle.

Partisanship in philosophy is the chief orientating factor. The structure of things determines the
structure of ideas. The progressive class, as the proletariat has proved itself to be, is the vehicle of a
more progressive ideology; this class is creating a unified and consistent Marxist philosophy. By its
very nature, natural science is materialistic, materialism and its roots lie in Nature. Natural science
spontaneously gravitates towards dialectics. To understand the problems of natural science properly
one must understand the only true philosophy--the philosophy of dialectical materialism.

**Question Three.** Only on the basis of the teachings of Marx, Engels, Lenin and Stalin can science be
fully reconstructed. The objective world--Nature--is primary; man is part of Nature, but he must not
merely outwardly contemplate this Nature he can, as Karl Marx said, change it. The philosophy of
dialectical materialism is an instrument for changing this objective world; it teaches how to actively
influence Nature and how to change it; but only the proletariat is capable of consistently and
actively influencing and changing Nature--this is what the teachings of Marx, Engels, Lenin and
Stalin--those unexcelled titanic minds--tell us.

The practice of socialist construction in the U.S.S.R. has raised a series of new colossal tasks that
only the proletariat is capable of fulfilling. The proletariat has proved this by its deeds. The Soviet
scientists have to face the most urgent problems raised by the construction of industrial plants, state
farms, collective farms on an enormous scale. These problems could be solved only in the land
where Socialism is being built and only with the aid of the philosophy of dialectical materialism
elaborated by Lenin on the basis of the principles of Marx and Engels.

**Question Four.** What is my opinion of the possibility of applying materialistic dialectics to
horticultural science and in what ways can this be done?

I must say that I have spent all my life in the orchard and on the garden beds. During my life I have
made a great many observations and studies of plant life. I have discovered hosts of new facts that
still await their theoretical significance to be investigated by science. Those facts must certainly be
thoroughly elucidated and investigated in detail from the theoretical standpoint. Here is where the
help of materialistic dialectics as the only true philosophy of consistent materialism is needed.

**Question Five.** What are the principal theoretical problems as regards the improvement of the
qualities of new fruit-plant varieties that require the most urgent investigation?

In my opinion the most urgent is the problem of accelerating the initiation of fruiting--making fruit
trees begin to bear at an earlier age. Next comes the problem of creating new plant species more
useful to man by means of interspecific hybridization. Then, I repeat again, a problem of major importance which should be tackled not by individual scientists, but by the united efforts of all scientists is the finding of ways and methods of introducing into the chemical composition of the fruit's flesh chemical elements hitherto unusual in the plant, but that are of great value to man.

Michurin Reference Archive
THE following three addresses were presented at a Conference on Genetics and Selection held in Moscow from October 7 to 14, 1939. Fifty-three scientists presented their positions at the open meetings of the Conference, but the principal disputants, representing widely different views on theory and methods in genetics, were Vavilov and Lysenko. Vavilov, director of the Institute of Genetics of the Academy of Sciences of the USSR, is the leader or one school of thought, while Lysenko, director of the Lenin All-Union Academy of Agricultural Sciences, is the principal spokesman for a Soviet trend in genetics which takes its inspiration from the work of Michurin, often called "the Russian Burbank." Because of their prominence and leading roles in the controversy, the speeches of Vavilov and Lysenko are here presented almost in full, together with the address of I. M. Polyakov who takes perhaps the most interesting intermediate position. Vavilov's talk is translated almost completely, only obviously unimportant remarks being omitted here and there. Considerably more has been deleted from the speeches of Lysenko and Polyakov. Since no time limit was imposed on the speakers, the Conference papers are long. Limitation of space unfortunately prevents our publishing the important addresses of V. K. Morozov, P. P. Dubinin, N. N. Grishko and (Madame) B. G. Potashnikova, all of which were printed, along with those of Vavilov, Lysenko and Polyakov, in Pod Znamenem Marksizma (Under the Banner of Marxism, 1939, no. 11).

The same issue of this famous Soviet philosophical periodical ran a general review of the Conference, and the previous issue carried a long critique and evaluation of the positions of the various speakers by the philosopher, M. Mitin. As head of the Philosophical Institute of the Academy of Sciences, Professor Mitin expresses more than other commentators the attitude of the Soviet government, which is vitally interested in the progress of genetics, as of science in general. In view of the charges, frequently heard in the United States, that the Soviet government uses its authority to curtail scientific disputes, it is interesting to note that the present conference was called by the editors of Under the Banner of Marxism in order that everyone should have the opportunity to present his case, and that the Soviet philosopher, Mitin, gives a most balanced judgment on the contending parties. Freely acknowledging the great scientific achievements of both Vavilov and Lysenko, he takes Vavilov to task for not bringing his theoretical work into close relation to practical work, for example, to that of the seed selection stations; but he also criticizes the followers of Lysenko for dogmatism and exaggerated claims. The widespread American interest in Soviet genetics and the wholly inadequate, often completely distorted, reports of the genetic controversy in the Soviet Union, which have appeared in our newspapers and scientific journals, reports which misrepresent both the content and tenor of the dispute, have prompted the editors of SCIENCE AND SOCIETY to publish the two leading papers of the last Conference together with a thesis intermediate between the two. It is to be hoped that these translations from the stenographic record of the Conference will help to dispel the misrepresentation and insinuation which has been fostered by reports of commentators in this country, and that with further knowledge of the issue and evidence in the case, they will be less inclined than heretofore to inject suppositional political motives into a scientific controversy.
ALL developments of genetics in our country date from the establishment of the Soviet regime. Professorial chairs in genetics have been established, the first in 1919-20. Soviet work in the sphere of genetics and selection has progressed rapidly. Especially since 1927, the date of the Fifth International Genetics Congress in Berlin after the Imperialist War, research has been in progress in the Soviet Union in practically every field.

We have no crises here. On the contrary, there is an expansion. A large active school of research workers has been created, embracing all the most important branches of contemporary genetics and, especially interesting for the section of philosophers, a division of experimental study of evolution.

What is the situation regarding genetics abroad? There, as is well known, far-reaching economic crises have taken place, sharply reflected in science as well. We see how Goldschmidt and Stern, important geneticists, had to flee Germany. Even in such a wealthy country as the United States one of the outstanding genetics institutes is closing—the Bussey Institute, near Boston, connected with Harvard University. In wealthy America the editorial board of the magazine *Genetics* must appeal to its readers for donations in order that publication of the magazine may continue. A number of selection institutions have been closed.

During the short space of time between the two last congresses, i.e., between 1932 (the date of the Sixth International Congress of Genetics in the United States) and 1939 (the Seventh Congress in Scotland) major advances have been made in our knowledge of the material bases of heredity, in elaborating the chromosome theory of heredity. The development of the work of Muller in mastering the mutation process leads to the deepening of our knowledge about the hereditary variations of mutation sequences. The findings of Painter have led to significant extension of our knowledge concerning the material basis of heredity and the structure of chromosomes. New tendencies are to be observed in the study of the causes of mutation. A series of interpretative works devoted to physiological genetics is coming out. If you were to take the program of the last congress, you would see that it was to a considerable degree devoted to problems of physiological genetics. It is necessary to remember that the leader of American genetics, Morgan, besides being a geneticist, is an important embryologist.

The Soviet scientist must not pass by these major events. We are now raising the teachings of Darwinism to grand heights. In this connection the great progress in world science through experiments in genetics must not be underestimated.

Let us turn to practical selection abroad. I shall indicate two important facts. On the basis of genetic research conducted by theorists and not by practical workers in the United States during the last few years, methods were devised for improving the yield of maize by outcrossing. The method was so widely used that in 1938 over 15 million acres of Indian corn were sown by this technique. According to official information received from the United States Department of Agriculture, this increased the yield by two and one-half million tons. In 1939, the acreage was considerably increased to 25 million acres. In our country about 5 million acres of maize are under cultivation.

The second major practical achievement of selection abroad on the basis of contemporary genetic theory is the discovery, in 1938, of an immune species of wheat in Canada. After one hundred years of effort it is now possible to stop the epidemic of stalk rust which here, in the U.S.S.R., is one of the greatest evils in the culture of spring wheats. Thanks to the immune species discovered by means of the crossing of various species the epidemic has been checked in Canada. The biology of rust is understood, in a significant measure, on the basis of the methods of genetics, which have led to increased understanding of the origins of new races of parasites. This is a novel, highly
interesting branch of parasitology, worked out completely on the basis of genetics and cytology. These facts are undeniable. The newly discovered immune species were sown in great quantity last year in Canada, in regions infected with rust. These new species stopped the epidemic and saved millions of tons of grain. Many other examples could be cited from various countries.

The last few years have witnessed the appearance of a great number of important general works and original monographs. After almost a ten year delay, the five volume manual on selection is being published in Germany under the editorship of Romer and Rudorf, summing up Western European practice and theory, and using to a great extent our Soviet experiments. This fundamental manual on selection shows clearly, both in its general discussion and in application to particular crops, the great significance of modern genetic theory in selection. At about the same time, there appeared the Yearbook of the United States Department of Agriculture comprising about 3000 pages in two volumes, devoted to the application of genetics to breeding, both of plants and animals. The very publication of these two volumes is historic. It shows that in the field of agronomy in the United States genetics plays the most active role.

I shall not enumerate a whole series of other publications on selection.

**Voice:** Could you, Nikolai Ivanovich, give the titles and authors?

**Vavilov:** "Yearbook of the U. S. Department of Agriculture" for 1936-1937. These volumes are published in huge editions (150,000) and are sent to farmers. Their contents show that the practical Yankees, who have given a great deal of attention to selection, are guided throughout by modern genetic theory. That is an indubitable fact. I do not know a single manual on selection in America or other countries, which does not give three-fourths of its space to genetic theory.

The rapidity of advances in genetics is shown by the fact that general introductions to plant cytology and genetics are obsolete before they appear. The fundamental work of Darlington on genetic cytology, which appeared four to five years ago, has already appeared in a second edition. Sansome's book, *Recent Advances in Plant Genetics*, published five years ago, was published this year in a second edition. Important works appear nearly every month.

Partly because of our disagreements, we are learning mainly from obsolete works, for example, Sinnott and Dunn, the basic American textbook, which is used in our schools in a translation from the 1932 edition. If you open the new American edition of 1939, you would not recognize many chapters. It is a completely new book, quite unlike the one from which we learn in our country.

We can point to a number of new books on genetics, such as Waddington, Sturtevant and Beadle, published this year. I dwell on these facts in order to show the activity in this field.

It is proposed that all this be repudiated. Soviet selection and genetics face a series of contradictions. It is impossible for this reason not to express deep appreciation to the editorial board of the magazine *Pod Znamenem Marksizma* for convoking this conference. It is hoped that it will dispel the prevailing unhealthy atmosphere.

Our first basic difference is in the interpretation of hereditary and non-hereditary variables. The foundation of contemporary study in selection and genetics appears to be, judging from all past work, the distinction between hereditary and non-hereditary variables, as exemplified in the terms genotype and phenotype, introduced by Johannsen. As the history of selection here and abroad shows, the most important achievements are closely linked with the acceptance of these concepts in the practice of selection.

Svalof selection station has been accepted by the common consent of geneticists and selectionists as the leading selection institution in the world for both theoretical and practical work. The practical results of this station are so important that even in our country, with a climate that differs from that of southern Sweden, we are able to make wide use of such varieties of oats as Victory, Golden Rain, Eagle, and others developed by this station. These varieties cover millions of acres in our country. In connection with the fiftieth anniversary of this station two years ago reports were issued
reviewing the great work which it had accomplished and the errors in methods which the station had
overcome. You will see from these accounts that at the basis of all practical attainments lies the
conception of phenotype and genotype, the differentiation of inherited and non-inherited variations.
In an empirical manner, the station succeeded in applying individual selection to self-pollinating
plants even before Johannsen. This method is grounded in theory and widely infused into practice
since the research of Johannsen.

And now Academician Lysenko appears to tell us that there is no distinction between genotype and
phenotype, that it is not fitting to differentiate between hereditary and non-hereditary variables, that
modifications are not distinguishable from genetical variations. Furthermore, affairs have gone so
far that the People's Commissariat of Agriculture, which follows attentively the developments in
science, as is indeed fitting in our country, has decided to change radically the methods of the
selection stations, according to the suggestions of Academician Lysenko who believes that the
inherited structure of species can be changed by upbringing, by the influence of agro-technical
methods. These changes in methods are being carried out at present under obligation in all our
stations, although no experimental data whatever has shown the necessity for the departure from
concepts experimentally worked out and accepted.

This question is basic to selection, and in order to change the methods of selection of self-
pollinating forms, substantial reasons and experiments are needed. These are not as yet in evidence.

Let us pass on to a subject which will be developed, of course, more fully by other speakers, i.e., the
chromosome theory. I shall content myself with the statement that the chromosome theory has been
in process of elaboration for not less than eighty years. Embryology is based on it. It is founded on a
colossal amount of factual material. One can hardly name another branch of biological science
which has been so carefully studied. Those who have become acquainted with the chromosome
theory are astonished by the quantity of work and its verification on the most diversified material.
When I studied in the laboratory of Dr. Morgan, and worked side by side with the most noteworthy
representatives of this school, I saw with my own eyes on what truly extensive, and exceedingly
precise experimental material the chromosome theory rests.

Great events have occurred in recent years in the application of the chromosome theory to the
sphere of remote hybridization of unrelated forms. What greater miracle can we imagine in our
biological science, comrades, than we are witnessing in the transformation of completely sterile
hybrids into fertile seed and pollen bearers, accompanied by a reduplication of the chromosomes
under the influence of specific factors.

Lysenko: Which factors?

Vavilov: Physical and chemical factors of which we know a great number. Particularly we must note
the remarkable work of Academician A. A. Shmuk in our country who founded the theory of
chemical induction invoking polyploidy in hybrid and non-hybrid forms. Dozens of chemical
compounds are available for this purpose. The latest work of Academician Shmuk, who is
unfortunately seriously ill at present, showed that one of these substances is colchicine, a readily
soluble compound which acts on many diverse kinds of plants. Physical agents, such as
temperature, and biological factors, as for example, the incision of plants, may also be effective.

This subject has particular interest, because more than half of all flowering plants are members of
polyploid series. There is no doubt that polyploidy has played an important role in evolution.
Polyploid induction has thus great practical as well as theoretical significance.

To deny the role of the chromosomes, to attempt tot explain everything in terms of organism as a
whole or of the cell, is to set biological science back a century.

The third issue which has aroused sharp and fundamental debate is Mendelism and the phenomena
of hybrid inheritance. This matter has already been developed in great detail. I will content myself
with asserting, as a plant breeder, that in the field of hybridization of plants reproducing sexually, it
is now impossible to conceive of work without applying the laws of Mendel. I. V. Michurin had a somewhat skeptical attitude towards Mendel's generalizations, because he himself worked with fruit trees which are reproduced asexually, making it possible to disregard many phenomena of extreme importance in sexual reproduction. Moreover, Michurin was aware of the complex heterozygous nature of the fruit varieties and species he used. He understood perfectly why it is possible to dispense with the laws of Mendel in the case of vegetatively reproducing fruits. But Michurin paid great attention to the achievements of genetics. I knew him intimately from 1920 on. It fell to me to persuade him of the necessity of preparing for the press the results of his work and to take part in the publication of his work in 1922-23.

I must point out that I. V. Michurin valued modern genetics so highly that he directed his students to your humble servant, i.e., a hundred per cent Mendelian and Morganist, at the Institute of Genetics, and some of his closest students are to a certain extent my students too, whom I infected with Mendelism and Morganism. They are here.

Voice: Are they still your followers?

Vavilov: I spoke at the beginning of my speech about the "mutation process" which has taken place in recent years, and perhaps you will explain the nature of this mutation process and possibly cause me to mutate too. (Laughter.) That is the reason, obviously, why we are here.

At the beginning of my work I too doubted the truth of Mendel's laws. Working at first chiefly on the problem of immunity of plants to infectious diseases, I went to England in order to study in this field under Professor Biffen whose works on the application of Mendelism to immunity were considered classic at that time. However, I came to doubt the Mendelian conclusions of Biffen. In the course of experimental study I became convinced that in many cases physiological properties depend upon many genes, that they cannot be disposed of in terms of simple relationships. But in the course of this work I also became convinced that in many cases simple genetic relations obtained, especially for morphological characters. I satisfied myself of the facts of the Mendelian relationships.

If you assembled a hundred of the most important practical selectionists of Western Europe and America, with great achievements to their credit, beginning with Nilsson-Ehle, Okerman, Rudorf, Romer, and said to them that there is a tendency among us to hold that it is not only necessary to remove Mendel from the list of classics, but also to regard his work as full of harmful generalizations, they would look at you, at the very least, as a very strange person.

I say this in order to show all the depth, all the practical importance of our divergences. All the practical advances connected with the application of hybridization to seeding plants, all the varieties introduced by way of hybridization, were obtained in the last decades by the application of the laws of Mendel. We must consider, of course, that many physiological characters are genetically very complex. We do not always deal with simple relationships. Some simple relationships do exist, for example the black and white color of ears of grain. The relationships are enormously more complicated when we go to physiological characters. If we study such a property as the baking characteristics of flours from different varieties of grain, it is very difficult to deal with it genetically. But even when we work with complex characters we must be guided by the rules established by Mendel, by the theory of polymorphous characters worked out by Nilsson-Ehle.

I go on to the next point. They tell us: "Stop engaging in sex hybridization. Replace sex hybridization by vegetative hybridization. The latter is much simpler."

Lysenko: Who said that and where did he say it?

Vavilov: In recent months I have had the opportunity of visiting a number of selection stations, and have seen how the work on ordinary hybridization was being abandoned, and the workers, especially the young ones, were engaged particularly with grafts.

Voice: At what station?
Vavilov: For example at the Polar Station.

Voice: There they have abandoned it altogether.

Vavilov: Yes, they have stopped occupying themselves with the hybrids of wheat and barley, and changed over to "vegetative hybridization." The only department where sexual hybridization is still applied, is concerned with potatoes.

As a matter of fact, is it not tempting to take the easier path instead of dealing with distributions, with generations, instead of carrying out long calculations and observations? It is simpler that way. Just graft an unstable variety on a stable sort and even on another stable variety, and then go ahead, multiply the scion on which the stock has to act in corresponding fashion.

M. M. Zavadovsky: Each stalk by itself?

Vavilov: Yes, I must say that here and there, this method is proposed.

Lysenko: Who proposes and where? You have not said that.

Vavilov: I said that this is being practiced in a number of stations.

Lysenko: Who proposes it and where?

Vavilov: Obviously, under your influence. It may be that I have misunderstood. If that is so, I should be extremely glad. In any case, it is your influence.

Lysenko: My influence has lasted only a year; yours has lasted more than twenty.

Vavilov: I don't want to speak either of my influence or yours. I have to speak of the modern point of view, supported by enormous Soviet and foreign experience. I consider it my duty to tell of this as a worker who has devoted three decades to plant husbandry. I consider it my duty to describe the situation in order to get a balanced account. What is happening is a serious disagreement not only with Vavilov, but with contemporary developments of biological science.

Prezent: Including Burbank.

Vavilov: Burbank was theoretically weak. I suppose I had better opportunities than others did to study Burbank and his work and his practical achievements. In the field of theory we need not take Burbank into account.

In approaching this question, we must once more keep in mind that we have a great deal of scientific experience in this subject. There are notable works of Winkler, Baur, and in this country, the works of Aseyeva and of Isayev on hydras, notable works which unfortunately are little known, because they were published in full only in English. These works show that even in the special case where the tissues of one form were interlaced with the tissues of another form, where they gave rise to complicated chimaeras, nevertheless the cells of the separate species did not vary their inherited individuality. This is brilliantly shown by experiments. Darwin considered vegetative hybridization to be possible, basing his opinion on some experiments known to him. But we must take into account the time at which these experiments were carried out. Great investigations carried out in the twentieth century have shown that sexual hybridization could not be replaced by vegetative hybridization. The very term of "graft hybrids" has disappeared from scientific literature.

I remember my student years at the Timiryazev Academy, when in a club of scientific amateurs, I had occasion to review Winkler's interesting work entitled "Tale of Gardeners." In this article the history of the study of the so-called graft hybrids was reviewed, which phenomena after all proved to be non-existent.

I am afraid of wearying you. I had occasion to go closely into this question, working on immunity to diseases. There were attempts to vary the immunity by way of "graft hybrids." Unfortunately, they did not give any results.

The physiology of grafts, the action of the scion on the stock and the converse, is another matter.
This question evokes great interest. This subject merits investigation. It is possible that new facts of practical importance will be discovered here. We must also take into account the after-effects, including the first sexual generations. In any case, the data of modern experimental physiology do not give us any ground for speaking of the possibility of the equation of sex hybridization to vegetative hybridization.

Let us pass over to the question of hereditary variation. No one among contemporary geneticists and selectionists upholds the unchangeability of the genes. In fact, genetics is the study of the variation of the hereditary nature of organisms. Mutation theory is the basis of genetics, as its history shows. However mistaken were many of the conclusions of De Vries, it is extremely significant that from the very beginning the phenomena of mutation were of the greatest interest to geneticists. As for the cause of mutations, and their production experimentally, that is another matter. It is essential to note that certain of the founders of genetics, for instance, De Vries and Johannsen, were outstanding physiologists. Nevertheless, even these leading physiologists were unable to control the mutation process in their day owing to experimental difficulties, although this was the primary aim of their experiments. But in contemporary work, it must be admitted that the experimental control of mutation is one of the most important branches of genetics.

The gene, in our opinion, cannot be regarded as absolutely unchangeable, although it remains stable and practically unchangeable over a period of generations. The study of cultivated plants shows that in practice we encounter a definite stability of form. We know that many varieties persist over long periods, sometimes even without further selection or purification. Even Johannsen, the author of the doctrine of pure lines, did not regard them as absolute. He observed the phenomenon of mutation in a series of plants. We may also recall the attitude of selectionists toward this doctrine. Our teacher, Professor Rydzinsky, tried for a number of years to refute the doctrine of Johannsen. In particular, attempts of this kind were made in Germany. Fruwirt, the author of a fundamental guide to selection, for a long time hesitated to accept the doctrine of pure lines among self-pollinators. Consequently, it is noteworthy that in the preface to the new edition of the German handbook under the editorship of the great practical selectionists Rudorf and Romer, published in 1938, they confirm the practical value of the doctrine of Johannsen on the basis of extensive tests of wheat, barley and oats.

I would like to dwell briefly on two matters connected with my own work on evolution in its application to cultivated plants.

Many years ago, on the basis of the study of variation in cultivated plants and of their close wild relatives, I proposed the law of homologous series in hereditary variation which is a development of the position laid down by Darwin in his book *Variation of Animals and Plants under Domestication*. Having noted the phenomena of the most extensive parallelism in evolution within the limits of species among closely related types and species of cultivated plants, we permitted ourselves to generalize them in the form of a law. The number of parallel hereditary divergences of this sort among related and unrelated species, especially among the first, is very great and each year opens up thousands of new facts.

The nature of this homologous variation consists, as I see it, primarily of a kinship of the genetic structure of closely related species and types. Likewise, it is the result of the activity of the environment of selection in a definite direction under definite conditions. In recent years we have observed a large number of instances of parallelism of ecological variation. We are not giving up and cannot give up this conception, for millions of facts attest to the prevalence of these phenomena. To ignore them is sheer blindness. A systematic as well as ecologic geographic study of cultivated plants leads us to recognize the great significance of this class of phenomena, which is not at all contradictory to phenomena of differentiation and divergence of species. These phenomena indicate a definite parallelism in the evolution of types which often possesses great practical significance. On the basis of this law I proceeded in recent years to study physiological characters and learned to find, in predictable regions, analogous forms for which we were
searching.

We are accused of attempting to fit the phenomena of variation into some sort of Procrustean bed. This accusation appears to us to have no factual basis. On the contrary, our theories have led us to discover a great number of new forms involving both physiological and morphological characteristics.

On the basis of our researches on the evolution of cultivated plants we have come in our day to the geographical theory of origin, to the notion of original species-forming regions of cultivated plants. We stand on that conception which appears to us to be purely Darwinian, for Darwin himself considered the facts of geographical localization of centers of origin of species as a fundamental biological law, and rye only apply it in relation to cultivated plants.

Summing up the findings on the immense amount of new material, in part still unpublished, we may say that, in actual fact, there are regions in which the process of species formation is particularly developed. The majority of formed species, among them cultivated plants, have not gone beyond the borders of the region of their origin. This is well shown in the case of wheat and rye here in the Caucasus, where recently a large number of endemic species have been discovered.

In developing the teaching of Darwin concerning the centers of origin of species of cultivated plants, we discovered a large number of new species particularly in primary regions. However, we do not wish to imply that species could not arise on the periphery, in secondary localities. On the contrary, we pay a great deal of attention to these secondary localities, and in the case of the most important cultivated plants we were able to establish extremely important secondary regions of species formation of cultivated plants. The authenticity of these findings compels every botanist and zoologist to reckon with the localities of origin and settlements of plant and animal species. Our opponents, while claiming to be consistent Darwinists, are, as it appears to us, in full opposition to Darwin. They try, with very little plausibility, to refute the role of fundamental regions of species formation, in essence a fundamental phase of evolution.

We have, of course, other differences. I have dwelt on the most important. The opposing point of view is in contradiction not only with a group of Soviet geneticists but with all modern biological science. I repeat that I do not know of one manual in genetics and selection which would support the views propounded by the school of Academician Lysenko. A peculiarity of our differences is also that under the name of progressive science it is suggested that we return, in essence, to views which science has outgrown, that is, to views current in the middle of the nineteenth century.

In order to do away with the anomalies which exist in the development of genetic science and the theory of selection in our country, I should like to propose, along with the widely distributed organ *Vernalization*:

1. The publication of another organ, which would print genetic works, not merely of a narrowly specialized character which we now print only in abbreviated form, in the *News and Reports* of the Academy, but also general articles, which could critically report on diverse views including those opposed to the ideas which are currently popular.

2. That the publishing house prepare and publish translations of the best foreign general works on selection and genetics. We are often obliged to use translated manuals ten years behind the times.

3. That conferences and sessions be called devoted to questions of genetics and selection, in order that various points of view may be aired.

4. That since the solution of many disputed questions is attainable only by means of direct experiment, it is necessary to facilitate the fullest experimental work, including, of course, that based on conflicting points of view.

5. And finally the last thing that I feel it my duty to stress as a scientific worker in the land of the Soviets, is the necessity of the introduction into the practice of selection only of tested and verified scientific experiments, of fully proved results. In order to introduce them into production, we need a
LYSENKO[3]

IN THE Soviet Union, the importance of science is recognized. Full opportunities for its development are present and, of course, far greater significance is attached to agricultural science here than in capitalistic countries. I need not point out to you that the correctness of agro-biological theory is of no little significance for our socialist agriculture.

I. should be glad if the Mendelians, who have so furiously defended their scientific positions, were objectively correct in science. What reason would there be in that case for not being in accord with their theory of the regularities of development of plant and animal organisms? It would be easier for me in that case, in my capacity as director of the Academy, to render scientific assistance together with the Mendelian geneticists to the organizations on the farms, to give advice on questions of plant and animal husbandry, and create a scientific plan, let us say, for furnishing varieties of winter rye and winter wheat, adapted to the rigorous conditions of Siberia.

On January 6, 1939, the Commissariat of Agriculture of the USSR and the All-Union Lenin Academy of Agricultural Sciences were commissioned to produce within 2 to 3 years a cold-resistant variety of winter rye for the snowless zone of the open steppes, and, within 3 to 5 years, to furnish a high yield variety of winter wheat, biologically adapted to the sub-taiga and the northern wooded steppe regions of Siberia.

If these varieties are not obtained within the given periods, our economic progress will be interrupted. Who will bear the responsibility for this? I believe, it will not be Mendelism or Darwinism in general, but principally Lysenko as head of the Academy of Agricultural Sciences and as an Academician in the Section of Selection and Plant Husbandry. So that if the Mendelians, mobilising their science, would give even a hint as to how to develop varieties of rye in 2 to 3 years and of wheat in 3 to 5 years, adapted to the rigorous Siberian conditions, is it possible that I would refuse? Of course not. Instead, I should welcome the valued proposal. The three years are not so far off. It is almost a year since the task was assigned.

The great successes of our excellent practice and of Soviet science are colossal, and generally recognized. I shall not speak of them, as it seems to me that the present conference wants to hear from me, principally, why I reject Mendelism, why I do not consider formal Mendelian-Morgan genetics a science. I shall answer these questions with some illustrations.

Take such an important question as seed supply. It is well known that the party and the government have provided all necessary facilities for supplying collective and state farms with new superior varieties, as well as with improved seeds of those varieties which are sown in the regions. Almost every district has its own seed selection stations with extensive experimental fields, and a great number of scientific workers. A government network of agricultural experiment stations has been organized, whose duties include the testing of the value of varieties far the different regions of the Union. There are many zonal and branch scientific experimental institutes, district experimental stations for plant and animal husbandry. There is the All-Union Academy of Agricultural Sciences, as well as the biological sections and institutes of the Academy of Sciences of the USSR and the Academies of Sciences of the Ukrainian and Byelo-Russian Republics. These institutions are intended to promote the rapid development and utilization of agrobiological science in socialist agriculture.

It is well known that one of the basic responsibilities of the selection stations (in addition to the introduction of new varieties) is the annual production of elite seeds of those varieties of grain which are sown in the particular district served by the selection station. An elite strain from the selection stations goes into commercial seed production, where it is multiplied and thence passes into the seed divisions of the collective farms.
How is it to be explained that elite seeds of wheat, barley, oats, and some other cultures have not been compared by any one, not even by the selection stations, with the ordinary good pure strains of the same varieties, with respect to yield, or other commercially important qualities? And yet without comparison there can be no attempt to improve the seed. Can this be explained merely by the carelessness of the men of science? I hardly think so. In the division devoted to seed supply the scientific men work hard. One or two might forget, but some one would ask the question: is the seed of the elite strain, say of the Ukrainka winter wheat, better or the same as the ordinary seeds of the same Ukrainka?

Among the millions of bushels of Ukrainka harvested every year there may be some thousands of bushels of seed better than the standard Ukrainka seed which might be issued as an elite strain by some selection institute. But as elite strains of seed have not been compared as to their native qualities with other seeds of the same variety, the possibility has not even been considered.

For people who are slightly acquainted with Mendelism, with formal genetics, it is obvious that elite strains of seed are called elite just because they are better than other pure strain seeds of the variety found in the collective farms. It was to be expected that sowing elite strains should give higher yields or that the winter shoots of these seeds ought to be more resistant to winter hardships, and so forth. However, according to Mendel-Morgan genetics, which unfortunately still continues to be taught by Mendelians in our higher institutions of learning, any seeds of self-pollinating plants within the limits of a single variety are alike with respect to their inheritance (genotype), regardless of the conditions of cultivation. The Mendelian-Morganists assert that the nature of the plant does not depend on agro-techniques. According to this pseudo-science, good agro-techniques cannot improve and bad cannot deteriorate the nature of the plant. And here is the reason why elite strains of seed are not sown by selection stations for purposes of comparison with ordinary seeds of the same variety. The very posing of the question as to the necessity of a comparison, if only to find a way to improve the seed, was considered and is considered unscientific, illiterate, by the Mendelians.

To us, followers of Michurin, it is clear that seeds of one and the same variety can be by their nature (genotype) better or worse. The nature of plants and animals can be improved or deteriorated. Hence, one of the basic tasks of the local selection stations is to do everything needed to improve, from year to year, the variety from which the elite seed is taken.

Our Soviet Darwinian agro-biological science must work out the scientific bases for the improvement of seed. This is indispensable in order that the elite strains of various cultures produced each year by the selection stations may be better compared to the seeds which they are destined to replace.

A second example: The Mendelians have continually blamed us (and still do), for not appreciating the teachings of Johannsen, and for taking a critical attitude toward this "classic" of biological science. We do not dispute with Johannsen, but with his present day followers. The same, naturally, with Mendel, Why should we disturb him who has departed and is at rest? But with his followers, with those who develop the conceptions of Mendel, we not only dispute, but we reject all their fantasies, because they interfere both with science and with practice.

As a matter of fact, why did we start to raise objections to the Johannsenists? Because the followers of Johannsen-Mendelian-Morganists-forbade by their theory such a practically proved method of improving plant varieties as beneficial selection.

For example, many agronomists and farmers know the spring wheat variety Liuteszens-062. This variety was initiated in 1911 at the Saratov selection station by means of selection of ears of the spring wheat Poltavka. The descendants of the selected ears were sown separately in order to determine which of them was the best. The descendants of one of the ears selected in 1911, having proved the best in the judgment of the selectors as the result of various tests, was called Liuteszens-062.
According to Johannsen's theory of pure lines, as our Mendelians understand it, any further selection of Liuteszens-062 and comparison with the original variety is not necessary. Selection within a so-called pure line, as Johannsen asserted, is ineffectual. But who will believe that the billions of plants of the Liuteszens-062 grown on millions of acres in various regions of the Union in the course of 20 years have not changed, but have remained the same? Who will believe that it is undesirable and unscientific to carry out a selection within such sowings? But a selection has not been carried out. Consequently, for over a period of 20 years, no new improved variety has been produced by means of selection from Liuteszens-062, as was done, e.g., in 1911 by selection from Poltavka.

The Mendelians assert that thanks to the theory of Johannsen individual selection began to be carried out on a wide scale. As a matter of fact, on account of the Johannsenists, beneficial selection in the practice of our selection work was, as a rule, discontinued on collective and state farms. This is why I disputed with Johannsen; not because I don't like Johannsen personally, but because the Mendelians support his theory, and propagandize for it in our advanced courses; and this has resulted in discontinuance of frequent selection and of year to year improvement.

Reflecting on this problem, experimenting, reading not only Mendelians and Morganists, but other authors as well, whose theories contradict the bases of Mendelism-Morganism, for instance such classics as Darwin, Timiryazev, Michurin, Burbank, and others, we came to the conclusion that there can not be pure strains in the absolute sense.

Plants change as a result of the conditions of life, and if plants differ, that signifies for us the value of selecting the best seeds in any generation as ancestors of a new strain. In this way also we came to understand the law discovered by Darwin of the biological usefulness of cross-pollination and the harmfulness of prolonged self-pollination of plants.

I shall not dwell on the work in intra-variety crossing of wheat. I say merely that if this question is approached not formally, but from the position of the theory of development, from the position of Darwinism, intra-variety crossing becomes one of the means of improving the seeds of grain.

In the course of our study of the biology of fertilization in plants, the question arose whether there was any scientific foundation to the requirement of an isolating zone one kilometer wide separating the bed of one kind of rye from the bed of another kind.

Working with seeds of self-pollinating plants (wheat, oats, barley) Mendelian theory insisted only on one thing: that the workers in sowing avoid admixture. To improve a variety by means of good cultivation and repeated beneficial selections was even regarded as illiterate by this theory. In production of rye seed on the basis of this same incorrect Mendelian science, all the attention was directed to only one thing: one variety of rye must be sown at a distance of not less than a kilometer from any other. If a planting of one variety of rye was for one reason or another less than a kilometer from a planting of another variety, then, in accordance with the instructions, the seed of both plantings was condemned and sent to the mill.

A biologist, naturally, should have kept in mind that in nature two varieties of cross-pollinating plants grow side by side, not a kilometer apart (e.g., varieties with white and red flowers). We need not think, of course, that in nature cross-pollination occurs rarely. Cross-pollination is more widespread in nature than self-pollination, and yet wild cross-pollinating plants preserve themselves fairly well in relative purity.

Starting from this and analogous examples, and also on the basis of experimental data we came to the conclusion that in the seed production of certain cross-pollinating plants it was unnecessary to separate the beds by much space to guarantee the impossibility of the cross-pollination of two varieties. In all the cases where the biological adaptive properties of the plant coincide with economic requirements, considerable isolation in space is not necessary (e.g., for rye, clover, alfalfa). For those plants whose biological adaptive properties do not coincide with economic requirements, isolation in space is necessary (e.g., for various sorts of beets, cabbage, carrots, and a
In discussing the needleless of the kilometer zone of isolation for planting of varieties of rye at a conference of the Commissariat of Agriculture of the USSR, the following interesting point was made. Experiments instituted by Academician N. V. Rudnitzky showed that the pollen of rye is carried by the wind in fairly significant quantities, not for one kilometer, but for much greater distances. As the experiments showed, this pollen does not lose its activity; its quantity is sufficient to fertilize other plantings. This means that if the varieties of rye are conserved and do not generate into a single variety, it is not because a kilometer zone of isolation is observed (as the Mendelians believe), but as a consequence of other biological causes. From their position, the Mendelians cannot understand the biological regularities, because not biological, but statistical regularities, lie at the basis of Mendelism.

As is known, the new instructions of the Commissariat of Agriculture of the USSR replace the one kilometer zone of isolation of rye by a 200 meter zone thoroughly acceptable to practical farmers. This zone of isolation is sufficient to prevent mechanical mixing of varieties.

Experiments instituted by us in the autumn of 1938 to ascertain whether the seeds of rye are deteriorated by non-observance of isolation in space, showed that not one well founded case of deterioration of rye seed through non-observance of isolation in space could be found. These experiments were carried out by comrade A. A. Avakyan at the experimental base of the All-Union Lenin Academy of Agricultural Sciences in the Lenin Hills. A series of experiments were undertaken also by leading government groups for testing varieties.

At present virtually no one raises a doubt as to the correctness of replacing the kilometer zone of isolation for planting of rye varieties by a two hundred meter zone, for in this question the Mendelians have been compelled to admit they were wrong. The trouble is only that, having in part recognized their errors, they still defend the false bases of their science, from which emanate the consequences undesirable in practice which I have discussed above.

I shall say a few words on the method of inbreeding. Some Mendelians declare: "Here, as a result of the attacks of Lysenko, Prezent and others, the selection stations have ceased work by the method of inbreeding, while in America, judging by some articles, many hybrid inbred varieties of corn have been obtained."

In the first place, we have never objected to breeding of related animals and plants with a view to selection. We objected to the incorrect method of inbreeding," to the cross-breeding of closely related plants and animals. In my articles I continually adduced examples, described experiments which showed how in accordance with Darwinism it was necessary to make use of related breeding.

To the Mendelians who point to America, I should like to say the following. Since 1935, that is, since the time I first pronounced the word of "inbreeding," only four years have passed, but previously, for a period of 10 to 15 to 20 years almost every selection station, working with cross-pollinating plants in accordance with your scientific instructions, used the inbreeding method on a large scale. Where are the results? Where is even one variety produced by this method? The Mendelians forget this, first of all Academician N. I. Vavilov.

Let us take up another example of our "attacks" on "classical genetics." The question is the so-called 3:1 relation. Why did I begin to deny one of the cornerstones of Mendelism, namely, the distribution of hybrid descendants in the relation (3:1)? Those Mendelians are correct (e.g., Acad. A. S. Serebrovsky and others) who asserted that the basis of Mendelism is (3:1). If actually the obligation in nature for the "distribution" of the proportion (3:1) does not exist, then objective existence cannot be accorded to the other Mendelian laws following from (3:1). Only in this way can it be explained why our denial of the "law" of distribution of hybrid descendants (3:1) as a biological regularity, evoked a storm of displeasure among the ideologists of Mendelism. The existence of the relation 3:1, obtained, as is well known to Mendelians, from the formula 1:2:1, as a mean statistical quantity, we have not denied and do not deny it. We merely say, that this regularity
It is necessary, if only in a word, to explain the meaning of $(3:1)$\(^n\). According to the doctrine of the Mendelians, this signifies that the offspring of any hybrid (just think of it: any hybrid!) of all plants and all animals must of necessity vary according to one and the same pattern, independent of the variety and genus of the animal or plant, of the conditions of life, or of any other possible influences. Always and everywhere it will be $(3:1)$\(^n\). All the difference is merely in the degree $n$. On the basis of such a theory, man is unable to direct the "distribution" of the offspring of hybrid plants.

In all my work of scientific investigation, this is, so far, the only case in which I declared in print without any experiment that it was impossible that this "magic spell," $(3:1)$, was observed everywhere and always in the animal and vegetable kingdom. Having thought through this question, I declared that it was not only impossible that the offspring of hybrids of various species and genera should be distributed according to one and the same scheme, but that it was also impossible that different offspring of hybrid plants of the same combination should vary in a uniform manner and degree. How the Mendelians raged at this! They declared that Lysenko and all who agreed with him were illiterate, even more, that Lysenko was a man, who, in the face of numerous facts staring him in the face, without any foundation attacked Mendelism. And what do you think? They said that the data supporting the "distribution" by families in the proportion of $3:1$ was infinite in amount. But at a test it proved that no one had such data, although as president of the Academy I asked for such material from Mendelians working in the Academy of Agricultural Sciences.

We deny the assertion that the offspring of hybrids of the same combination must vary according to one measure and degree. Let us assume that two individuals are crossed, say two fishes, and hybrids are obtained. Let us say, a hundred hybrids. All these hybrids have one father and one mother. Now it is necessary to show, in order to verify the Mendelian claims, that the offspring of these hybrids, each pair apart, must vary in a uniform measure and degree, and secondly that the variation of the offspring (of each pair of hybrid fish) will be uniform, will not depend on the condition of life (upbringing) of the hybrid parents. That is what it would be necessary to show. But Comrade Kirpichnikov has told us: fish are such a good object, for in one family one can have as many as 100,000 offspring, and these offspring vary in the proportion of $3:1$. Comrade Kirpichnikov said that in other combinations he got $2:1$. But he did not say a word about how many families there were of one and the same combination, and what was the variation in various families of one and the same combination. On that he was silent.

Voice from the audience: Not so, not so.

Lysenko: I would be glad to hear and change my opinion, if I were shown that, let us say, with fish in hybrid offspring, by families, in different circumstances there obtained one and the same variation, After I ventured to make a public denial of the existence of $(3:1)$\(^n\) as a biological regularity, quite a number of experiments on this question were instituted in the All-Union selection-genetic institute (Odessa) and the experimental station of the Academy (Lenin Hills) by Comrades Avakyan, Yermolaev, and others. As a result of these experiments and others I am more fully convinced that not only is there a different "distribution" of offspring of different hybrid plants of one and the same combination, but in some cases hybrids are obtained which give offspring invariant in practice, i.e., not "distributed." The practical significance of recognizing or not recognizing $(3:1)$\(^n\) as a biological regularity may be inconceivable to some. To us who are Darwinists, and I imagine to the Mendelians too, it is very clear, that whether a man recognizes it or not will make a big difference in his practical work of selection. The recognition of $(3:1)$\(^n\), the recognition of a uniform measure and degree of variation of all hybrid offspring in this or that combination, led to a situation where people simply paid no attention to the conditions of growth of the first generation of hybrids. No matter under what conditions the different hybrid plants of the first generation of one and the same combination were placed, the seeds would be uniformly distributed; as K. A. Timiryazev said in his time, mocking the Mendelians: three for papa, one for mama, or vice versa: three for mama, one for papa.
Further. If the offspring of all hybrid plants varies according to a uniform measure and degree, then why choose, thresh, and then sow the offspring of each hybrid plant separately. It is easier to mix them all, thresh them all together and sow them all together. At the vast majority of selection stations that is what was done. They took all the plants of the first generation (of the same combination), threshed them together and sowed the mixture obtained. Then from this artificially, mechanically made mixture they fished out (calling it selection), at best in the second generation, usually in the third or fourth generation, single plants and then sowed their offspring separately.

If we do not recognize it as fatal predestination that the offspring of hybrid plants of one and the same combination must vary in a single measure and degree, then the selector must act quite differently. He must take care that by creating suitable conditions of growth (in the Michurin way) he directs the development of the hybrid plants in the desired direction. For plantings of the following generations he must choose the best individuals included among the plants of the first hybrid generation. Other propositions, practically important and diametrically opposite, follow according to whether we recognize or do not recognize (3:1).

Acad, N. I. Vavilov has frequently said to me, that in the literature there is as much material as you want to support the existence of the distribution by families in the proportion (3:1)."

To finish up this examination of the unfortunate relation 3:1, I may say that one Mendelian tried in print to make a factual support of the existence of 3:1, but it was not altogether successful, and so far he is the only one.

At this conference we have frequently heard from the Mendelians that it is impossible to improve the breed (genotype) of a variety by agro-technical means. At the same time a group of comrades who share the views of Mendelism have maintained in informal discussions that no Mendelian denies the necessity of the application of sound agro-techniques, the application of fertilizer, etc., on seed plots. They have already forgotten that N. I. Vavilov declared from this very platform that "world" genetic science does not recognize the possibility of changing, improving the breed of seed by means of agro-techniques, just as he does not recognize the possibility of improving the breed, e.g., of horned cattle by means of good care and food. Has N. I. Vavilov too forgotten this?

We deny that the quality of the breed (genotype) does not depend on the conditions of life. We maintain that on the seed plots of farms and selection stations it is necessary always to apply the best possible agro-technique, since that not only increases the yield of seed per unit of area, but, most important, it improves the breed of these seeds. On the logic of Mendelism, it makes no difference whether there be good or bad agro-technique.

Voice: Not so, the quality is improved but not the nature.

$Lysenko$: Mendelism asserts that no matter how pedigreed cattle are kept, their breed will be no better and no worse than it was.

This example shows anew that our Mendelians no longer say in what the essence of their science consists, they try either to be silent as to the concrete consequences which follow from their theory, or they reduce the dispute to trifles. It is especially current among them now to declare that they are being oppressed, restrained, that Mendelism-Morganism is not being allowed to develop. In point of fact, all the oppression of Mendelism can be expressed in the proverb, "The bear claws the cow, but roars himself." (Laughter.)

But let us return to the question of the role of Mendelism in the solution of the practical-questions of agriculture.

Certain Mendelians, in particular Acad. N. I. Vavilov, made the following statement here: at any rate, the varieties grown on millions of acres in our Union were introduced on the basis of Mendelism. Even some of the selectors, the authors of these varieties, may declare that they share in agro-biological science the views of Mendelism.

How do matters stand in point of fact? Can it be that Lysenko, Prezent, Avakyan and others are
unfair to Mendelian genetics? Let us settle this question too.

Acad. N. I. Vavilov and a series of other proponents of Mendelism have been repeating that all selective practice the world over has used and is using Mendelian genetics in its work. Such asseverations have an effect on certain comrades who take them at face value. But let us hear what these same Mendelians said on this very question some years back, when they were not engaged in controversy with the followers of Michurin's theory, when Mendelism, so to speak, "flowered" luxuriantly in our land and when the Mendelians had more opportunities than they now have of breaking, of hindering the development of Michurin's theory. Here is what one of the leading Mendelians wrote on the question whether selectors here and abroad used and use Mendelian genetics. I shall not give the name of the author yet, make your own guesses and compare these assertions of his with what he says now.

"It must be said definitely that the work of selection in our land as well as abroad was characterized in the past and is characterized by a divorce from genetics. The vast materials on practical selection, as a rule, are not worked over genetically at all and disappear without a trace into the archives. Very often we have no documentary data at all on the derivation of varieties."[4]

"Frequently selectors, even consciously, reject genetic interpretation of their materials. This divorce of genetics from selection is especially characteristic of Western European selectors, but occurs also in Canada and in the United States as well, where selection is in the main concentrated in the hands of seed firms."[5]

But N. I. Vavilov, as you heard, especially emphasized here that in Western Europe and in the United States all the work is done in terms of the Mendelian theory.

Further: "When you visit important selection centers abroad, you often hear from selectors that genetics is entirely another matter, we have nothing to do with that, we never read genetic books, we carry on the work of selection, we do it by intuition, by our own methods, we get something from you once in a while, but between you and me, there is a great gulf."[6]

What is your opinion: do these assertions resemble what N. I. Vavilov said in the last year or two and is still saying? Here is what the same N. I. Vavilov said not so long ago at a genetic conference called under his chairmanship. The resolutions of this conference say:

"The divorce of genetics from practical selection which characterizes the work of investigators in the United States, England and other countries must be resolutely removed from the genetic investigations in the USSR."[7]

Voice: Right.

Lysenko: Who says that is wrong? You Mendelians said from this platform that the varieties we have derived on the basis of your Mendelian genetics.

Acad. A. S. Serebrovsky yesterday, and today too, said that in any case the breeds of animals were derived on the basis of Mendelism. He considered even Acad. M. F. Ivanov a Mendelian. But this is what A. S. Serebrovsky wrote in 1932 in the Proceedings of the same conference:

"The character of the subject matter greatly influences the selection of problems and we have extraordinarily richly worked-out chapters of genetics, closely connected, e. g. with Drosophila, and complete lack of elaboration of such chapters as would have especial importance for our agricultural economy."

"... It is possible, for example, to take the good manual of Prof. Davidov The Selection of Milch Cattle, in which there is judiciously collected all the scientific material in the field of selection and attempts are made at systematic exposition of the science of selection, standing on the level of our present knowledge."

"And what do we see? We see, summing up, that we have scraps, shavings of knowledge, which after all can not often be directly applied to our practical work."
"And at the same time, in order really to organize selection, in order to be master in the genetics of large horned cattle, we need to know a hundred times more, and to know things to which at present little attention is given. Almost everything has to be begun from the beginning."

And, comrades, when they ask what part of Mendelism to keep, in order that the Lenin Academy of Agricultural Science may successfully carry on scientific work in animal breeding and seed production, I always answer: almost nothing.

I read to you the assertions of Acad. N. I. Vavilov on seed production and of Acad. A. S. Serebrovsky, who was the leader of the science of breeding. Both with especial clarity declared (and this was not so long ago) that Mendelian genetics has no relation whatsoever to the derivation either of varieties of plants or of breeds of cattle. Now however N. I. Vavilov and A. S. Serebrovsky assert the diametrically opposite and thereby prevent an objective and correct examination of the essence of Mendelism.

The impression prevails among some comrades that, although the theory of Michurin is moving forward rapidly in our country, although ten and hundreds of thousands are occupied with this theory (and this is actually so), nevertheless there are more people who hold Mendelian views. In the work already cited it is shown that when the conference was held in 1932, there were 33 specialists in general genetics and 86 in special genetics. That is how many Mendelian geneticists there were in 1952. But perhaps, the number of Mendelian specialists has greatly increased since 1932? The plan of this same conference envisaged by the end of 1937, 113 specialists in general genetics and 259 in special. But I am convinced that this plan too was not fulfilled, inasmuch as the theory of Michurin, his methods of work, are growing and are enveloping the Mendelian ranks too. That is what is crushing Mendelism! The Michurin theory is crushing it! It kidnaps the adherents of Mendelism, who go over into the ranks of the anti-Mendelians. The Mendelian geneticists, silent about their fundamental differences with the theory of evolution, with the teaching of Michurin, with the facts of practical life, put all the blame for the crisis of their theory on criticism from the side of the Darwinists-Michurinists. And in the addresses at this conference it was possible to hear that the divergence between Mendelian and Michurin genetics is not due to a difference of principle between these two scientific tendencies, but to an "unsound" criticism of Mendelism.

Genetics is an interesting and practically important part of agrobiology. It is the science of the regularities of inheritance and variation of plant and animal organisms. The more, and the more truly, we discover these laws, i.e., the better we master in practice the development of the organism, the more quickly and radically we will be able to improve and to adapt living nature, the varieties of plants, the breeds of animals, to the demands of our socialist land.

I do not know of any biologist who has so deeply penetrated the laws of inheritance and variation of plant organisms as I. V. Michurin. He found practical solutions to some of the deepest questions of theory. By this step he got a splendid confirmation of his theoretical assertions. It would be the grossest error to deplore that I. V. Michurin gave us, the Soviet land, only hundreds of good varieties, but not his theory, not the method of their derivation. Michurin wrote many excellent substantial works, which are in constant demand in our country. It is with these works that we must approach that science which is called genetics. The work of the Stakhanovites in animal husbandry, and the experiments of scientific workers disclose the inaccurate basis of Mendelism-Morganism. Moreover it is not a secret even to the representatives of Mendelism-Morganism that if vegetative hybrids are possible, then the only thing left of the so-called Morgan chromosome theory of inheritance is the chromosomes, and the entire theory of Morganism falls to the ground.

Darwin had called attention to the deep significance of vegetative hybrids, showing that when this field was developed then sooner or later we would have a different understanding of the sex process too. It is understandable why the Morganist geneticists did all they could to show the impossibility of vegetative hybridization, and denied the essence of Michurin's theory of the action of mentors. I. V. Michurin gave us many splendid varieties, in the process of deriving which he used the
method, worked out by him, of the mentor. At the top of a tree of the young variety he grafted a shoot of another variety so that by the action of the grafted branch of another nature he might change the nature of the young variety in the desired direction.

The Morgan geneticists were able in their time to hush up this matter, as they put it, to declare that it was scientifically unproved, an error, etc. Only a few years ago I was a witness as such scientists as Acad. A. S. Serebrovsky and others declared from the platform that the theory of I. V. Michurin on mentors and vegetative hybrids was a fancy based on errors.

Again A. S. Serebrovsky recently declared that the "Northern Beauty" (an excellent variety of cherry of Michurin's) never had white fruit. However, I. V. Michurin wrote that he obtained a hybrid with white fruit from two varieties of cherry (vishnya and chereshyna). The bush of the young sapling failed at its roots, nut it is known from the works of I. V. Michurin that cuttings of this young sapling which had not yet established its breed were grafted to a cherry stock (vishnya). When the grafted tree bore fruit, it appeared that the fruit had received a red shade from the stock. This is the variety "Northern Beauty"--with red fruit.

Formal geneticists, believing that the heredity of the organism is due to a special discrete object located in the chromosomes, naturally cannot accept vegetative hybrids if only for the reason that chromosomes from the stock cannot go over into the scion. To grant that heredity, i.e., the capacity of organisms to resemble their ancestors and parents is not some special substance, but a property of any living cell, any living particle from which the organism develops, is an impossibility for the Morganists, inasmuch as thereafter there would be nothing left of their theory.

It became particularly difficult for the Morganists and Mendelians then, when it was not longer possible to deny vegetative hybrids when this matter had broken out on a broad front, because many hundreds of experimenters had become engaged in this deeply theoretical question. Vegetative hybrids came pouring out as from a cornucopia. Then the Mendelians took alarm and began to cry suppression. But as a matter of fact it was not suppression of the Mendelians, but something quite different.

The essential point is that when vegetative hybrids began to be accepted by many scientists and experimenters in various regions of our country, it became much more difficult for the Mendelian geneticists to be silent about the basis of the Michurin theory. In the chairs of the higher institutions of learning and in the institutes of the academies it became harder for the Mendelians to "suppress" the Michurin theory, to borrow one of their expressions. In point of fact, the Mendelians cannot adduce one confirmed instance of suppression of their work, even in the Lenin Academy of Agricultural Science.

It would be possible at this conference to adduce many results of experiments with vegetative hybrids, carried out by scientists and experimenters in the most diverse regions of our land, in the Frunze region of Moscow, in the Institute of Potato Husbandry near Moscow, in the All-Union Selection-Genetic Institute (Odessa), at the Lenin Academy of Agricultural Science, Lenin Hills, at the All-Union Institute of Plant Husbandry (whose director is Acad. N. I. Vavilov) and many others.

From the Lenin Academy of Agricultural Science I took a part of the exhibits of vegetative hybrids, in order to demonstrate them here. Not all of these hybrids were obtained by me, many not even under my immediate direction. Each scientific worker, aspirant or experimenter obtained them independently, in divers regions of the USSR, but the process was a single one.

I proceed to demonstrate exhibits of vegetative hybrids obtained this year by various experimenters. The "Humbert" tomato is well known. It is well known that the fruits of this variety are not round but elongated. Ordinarily they go to the canning industry. Cuttings of young plants of the "Humbert" variety were grafted on plants of another sort of tomato, "Ficarazzi," which is an early tomato, whose fruits are markedly different from those of "Humbert," being of round form and strongly ribbed. In the given experiment the part above ground, what is called the top of the plant,
was of the nature of "Humbert," but the under part—the roots and a part (10-15 cm.) of the steam—had the nature of "Ficarazzi."

The seeds gathered from the graft of "Humbert" were sown, and in this way the seed generation was obtained. From these seeds there grew plants giving fruit which in some cases were not all similar to the fruit of "Humbert." There were some plants, e.g., whose fruit had a perfectly round form, but at the same time were not ribbed but smooth, like "Humbert." Plants were also obtained giving fruit whose upper part was round, but the very base, near the fruit stalk, resembled in form the fruit of "Humbert." On some plants the fruits strongly resembled the fruit of "Humbert." Finally, on some plants the fruit have a different form. Indeed, on one and the same cluster there were fruits almost entirely like the fruit of "Humbert," and other fruit almost entirely like that of "Ficarazzi." There were also fruits representing various intermediate stages between the two extremes.

In this case, accordingly, there could be observed on the specimens shown by me not only alterations of the breed of the tomato "Humbert" by the action of the graft of "Ficarazzi," but there were clearly to be seen in the seed offspring characters of both breeds of the two components which had been united by grafting. I believe that there is every ground for calling these plants, grown from seed, hybrids obtained by vegetative means.

This work was carried on by comrade Kovalevskaya, a collaborator of the All-Union Selection-Genetic Institute (Odessa).

Here is another example from the work of Comrade Alexeeva. She grafted the "Ponderosa" tomato, which has large round fruit, on the perennial nightshade "Dulcamara." Seeds obtained from the grafts were sown and at the same time seeds of the pure strains were sown as controls. From her experiment I took, as an exhibit for the Academy, what I considered the most interesting—a vegetative hybrid of "Ponderosa" with "Dulcamara." Casts of these fruits are in my possession. On isolated plants fruits were obtained reminding one of the form of "Dulcamara." Instead of the large round fruit of "Ponderosa" fruits were obtained not larger than those of "Humbert," elongated as with "Dulcamara," but in clusters, so far as I remember, of about 90 fruits. Never in any variety of tomato, have I seen such clusters with such quantities of fruits. The form of the fruit differed from that of "Ponderosa," but greatly resembled the fruit of "Dulcamara," i.e. the former stock. In the experiments of comrade Alexeeva it was easy for me to observe further that on one end of the same plant there were frequently fruits of differing form.

In general this example too indicated that the plants obtained by comrade Alexeeva from seeds are similar as it were to sexual hybrids. The plants referred to had fruits reminiscent of the form of the former stock. Moreover, comrade Alexeeva obtained many plants diverging from the original varieties taken to be grafted.

I can exhibit also casts of vegetative hybrids obtained by comrade Avakyan at the All-Union Selection-Genetics Institute (Odessa). A semi-wild variety of tomato, "Mexican Red," was grafted on the tomato "Thunder Rose." On the scion, i.e., on "Mexican Red," fruits appeared quite unlike the fruits of that variety. Instead of two-chambered fruits, four-chambered and even twelve-chambered fruits were obtained. It is true, that comrade Avakyan has not yet succeeded in obtaining seed offspring from these grafts.

I show some further casts which describe how the form of fruits, under vegetative hybridization, may be communicated from one component to the other. Comrade Kovalevskaya at the same All-Union Selection-Genetics Institute grafted "Humbert" to the Bulgarian sweet pepper. Seed from the graft of "Humbert" were sown. In some plants of this sowing, fruits appeared strongly reminiscent in form to sweet peppers.

It is also interesting to mention here that plants—vegetative hybrids—are obtained which are unstable in their nature, which vary. The same thing occurs as with sexual hybrids, where a difference of characters is found not only as between different individuals, but also within the same plant.
I believe it will not be a great error, if I say that vegetative hybrids are hybrids obtained by means of special nutrition. After all, what is a graft? A slip of one breed is grafted to another breed, an interchange of saps takes place, of plastic substances secreted by these two stocks. The body both of stock and of scion is built of substances unusual for the given breed and thus the properties of the cells of the scion and the stock are obtained in various cases in varying degrees, different from the type, the breed.

I believe that in recent times the Mendelian geneticists may easily grant that in cases of grafting inheritable alterations may be obtained, but so far they do not grant that these alterations have the hybrid character. They do not want to recognize that in the organisms obtained in this way it is frequently possible to discover some of the properties of both breeds, that is, the properties of the plants which in the previous generation were united by grafting. It is understandable that the Mendelian-Morganists cannot agree with this position, without breaking with their basic theory—the so-called chromosome theory of heredity. If we agree that heredity, as they say, is found only in the chromosomes, then how are we to explain the facts of the transmission by means of the interchange of nutritive plastic substances between the grafted components?

I emphasize that the facts of the transmission of characters and properties of plants by means of vegetative hybridization is no longer a rarity in the Soviet Union. I have exhibited to you the transmission of forms, of color and of the number of chambers in fruit. It would be possible to point out also that Michurin has given not a few examples of the transmission of the length of the vegetative period. Thus he made a breed of apples with early ripening fruits into a winter variety by means of a mentor, i.e. by vegetative hybridization.

I believe that it is possible to unite into one breed characters and properties of two breeds in a vegetative way, as well as by sexual hybridization. With this view of the phenomena of heredity, it is naturally impossible to agree with the theory of Mendelism-Morganism. If this theory is uncritically accepted, one must deny the possibility of the existence of vegetative hybrids, and that is what the Mendelian-Morganists do. But naturally those who have seen vegetative hybrids, have obtained them themselves and know how to obtain them, will take a different view. If one understands even in a general way how vegetative hybrids are obtained, it is not hard to imagine in what way the heredity of organisms changes with suitable environment, with suitable nutrition of the plant. The means of feeding and the quality of the food play a colossal role in altering the heredity of plants and animals. Not in vain did Acad. M. F. Ivanov place at the head of one of his articles the saying of English stockbreeders: "The breed goes through the mouth."

From the factual materials at hand it is clear to us that to alter the breed, to combine the hereditary qualities of two different breeds, is possible even without the "passing-over" of the chromosomes of these breeds, i.e. without the immediate transmission of chromosomes from one breed to another. For in vegetative hybridization, as I have said, the chromosomes do not "go" from stock to scion or vice versa, but the properties of heredity can be transmitted as well by means of the interchange of plastic substances.

Mitin: But to know these chromosomes, generally speaking, is not a bad thing.

Lysenko: When have I said or written that it is not necessary to study the membrane of the cell or the chromosomes? Who of us has said that it is not necessary to study the chromosomes? But I cannot, while speaking on one subject, speak of another as well. Concerning chromosomes, I will say merely that any hereditary properties can be transmitted from one breed to another even without the immediate transmission of chromosomes.

No one of us has said or says that the chromosomes do not play a great biological role in heredity. But Morganism-Mendelism forbade studying the biological role of chromosomes. They transformed cytology into cyto-genetics, i.e. instead of studying the cell as such, the Morganists reduced everything to the count and the morphology of the chromosomes alone. The study of the biological role and significance of the chromosomes is a most necessary matter, and as president of the V. I.
Lenin Academy of Agricultural Science I am bound to aid it in every way. And it is only on my initiative that the cytologist, comrade Chernoyarov, appeared and spoke at this meeting. For a long time he has been struggling against cyto-genetics, which diverts a science from a genuinely biological understanding and study of the, cell and its constituent parts.

In conclusion, I may say the following: It is in vain that the Mendelian comrades declare that we preach the end of genetics. For our socialist practice, for our agricultural science, and especially important for such an institution as the V. I. Lenin Academy of Agricultural Sciences, genetics is necessary, and we fight for its development. One has to be naive to think that the genius of biology, I. V. Michurin, recognized by the party and the government, and the country, would not take from Mendelism all that had to be taken for the production of varieties. What Michurin gave in his splendid works, he took from various sources, and above all from his own practical labors.

I am willing to take from Mendelism all that I. V. Michurin took from it. But he, so far as I understand the essence of his theory, took nothing at all from Mendelism. One has to know how to choose authorities in science. Only that theory which helps you in practical solution of problems undertaken or assigned, earns the right to scientific labors. Mendelism and Morganism not only have not helped, but have frequently hindered. That is why for me the theory of Michurin is a colossal authority in agro-biology, while the theory of Mendel and Morgan on the other hand I can only call false.

At the present conference comrade Zhebrak spoke of the hybrids he has obtained between "Timofeevka" wheat and "Durum" wheat. Let people who do not recognize Mendelism-Morganism obtain such hybrids in other ways, he said. My answer is that the obtaining of these hybrids, whose practical value only the future will tell, has no relation whatever with Mendelism-Morganism. Besides, in what does comrade Zhebrak's result in obtaining of hybrids between varieties differ from the result of the work of comrade Philippov, a young scientific worker of the Institute of Potato Husbandry?

As is known, the wild form of potato "Acaule" is extremely difficult to cross with domesticated sorts, belonging to a different species. Previously in our Union hybrids between these forms of potato were obtained only once (in the Institute of Potato Husbandry). These hybrids however were almost totally wild, despite the fact that they were repeatedly crossed with domesticated varieties and in ordinary field conditions did not give tubers.

Comrade Philippov attacked this problem in a Michurin way, and easily and simply removed the existing obstacles. In a vegetative way, by means of grafts, he brought together these two genetically distant breeds. When flowers developed on the slip of "Acaule," he crossed it with a domesticated sort. The domesticated stock had such an influence on the slip of "Acaule," that the cross took place easily enough. From the seeds of this cross some plants were obtained, which, in many ways resembled the domesticated sort of potato and yet had some characters of "Acaule." Some of these plants, under ordinary field conditions in 1939, gave not a had yield of tubers. This work of comrade Philippov, whose practical significance can be determined only in the future, differs in literally nothing, so far as theoretical difficulties are concerned, from what comrade Zhebrak reported on here. The approach of these two scientists is completely different.

Comrade Philippov chose the reasonable path, the true one, worked out by I. V. Michurin and often tested by him. The path which comrade Zhebrak is taking is an accidental path, soon forgotten, which receives great attention only now because the Mendelians and Morganists need something to cling to in order to defend their invalid science. Things have gone so far that the whole theory of Mendelism-Morganism is frequently reduced by some Mendelians to colchicine. Now this colchicine (a strongly poisonous substance) has no relation whatever with the direction of this theory. They identify the multiplication of the number of chromosomes in the cells with the action of colchicine. There is no doubt that plants will change if the number of chromosomes in the cells is increased or diminished. But it would be wrong to think that any duplication of the number of chromosomes in the cells will always lead to the same results.
The diminution or increase of the number of chromosomes in the cells of plants takes place often enough in the most diverse circumstances. In various cells, under various conditions, a uniform increase in the number of chromosomes will give of course diverse results. But it is a mistake to regard poison-colchicine, under the action of which the plant cells develop abnormally, as a kind of panacea. After a year or two have passed, I think that the enthusiasm of the Mendelian geneticists for colchicine will have subsided.

I have continually told the Mendelian geneticists that even if we were not at odds, I should not be a Mendelian. The important thing is not to dispute; let us work in a friendly manner an a plan elaborated scientifically. Let us take up definite problems, receive assignments from the People's Commissariat of Agriculture (N.K.Z.) of the USSR and fulfill them scientifically. We may argue about the way of fulfilling this or that practically important scientific work, or dispute as to the correct methods, but not aimlessly.

I trust, that the editors of the magazine Pod Znamenem Marksizma will help us in this task.

**POLYAKOV[8]**

IN ORDER to make genetics actually a leading science, genuinely serving our socialist construction, we have to revise critically a whole series of basic propositions of our genetic science.

A number of the speeches showed that the comrades are thinking more of the old than the new. The impression is given that if Academician Lysenko did not exist, if Lysenko did not make sharp criticisms of genetics, then in general all would be calm and peaceful, and nobody would hinder us, as somebody expressed it here, from "working quietly." Lysenko appeared and began to "hinder" us from working.

It is very good that Lysenko began to hinder us from working in that sense!

How did N. I. Vavilov speak N. I. Vavilov told us various good things about the achievements of world science. This material was in part known, in part unknown. But this story is of little use. What was needed, Nicolai Ivanovich, was a serious critical analysis of every point on which you spoke; it was not necessary for you to bow slavishly before foreign science. I say before the whole auditorium that I esteem you highly as a scientist. You personally have done significantly more than Bateson. But for some reason Bateson and others play a very big role in your speech, and continue to blot out the achievements of our science. You can advance science, but you do not do so sufficiently. I am referring to those theoretical genetic subjects, which you discussed, since I value very highly your scientific work in assembling a world collection [of wheat varieties] and your analysis of the paths of evolution of cultivated plants.

What did Comrade Levitsky say here He said that there should not be a speculative, as he cautiously put it, criticism of genetics. What is meant by a "speculative" criticism If we are to speak of a criticism which is arbitrary, bad, untrue, ill-advised, of course, that would be superfluous. But if by "speculativeness" there is implied the well-known attempt to avoid criticism of fundamental concepts, then we differ with you. We are for such criticism.

Permit me to pass to the consideration of a series of problems, and present my conclusions with respect to them. I begin with the problem which naturally should engage our attention above all--the problem of hereditary variability, of variations in the hereditary nature of the organism. Has genetics been successful in dealing with this problem? Not by any means. It is unnecessary to remind you that many adopt the position of autogenesis. When the well-known work of Muller appeared on the X-ray production of mutations in Drosophila, Serebrovsky published an article whose title, if my memory does not betray me, was "Four pages which shook the world." In my opinion, these four pages may not have shaken the world, but only A. S. Serebrovsky, because he accepted autogenesis.

It is very often said that the experimental production of mutations is the greatest achievement of the
geneticists. Mutations are obtained with the aid of X-rays, ultra-violet rays, radium and various chemicals.

It is impossible to be arbitrary with respect to these works and deny everything. But, in my opinion, there is here the same sort of "unity of the internal and the external" as, let us say, when we take a stick and break the leg of a dog with it. Is it possible in this case to speak of the unity of the stick and the dog? It is doubtful.

But I think that when we take X-rays and other agents, we take something like a stick and beat the organism with it, we knock out something. Of course, something is changed, and we get a new result. It would be strange if it were otherwise. But are we getting any nearer to solving the basic question: the role of external factors in the mutation process? It would be an oversimplification to underestimate this stage in the development of genetics and to maintain that it will give us nothing; that in my opinion would be wrong. The elaboration of a series of experimental procedures sometimes enables us to obtain variations, and solves certain methodological problems. Certain variations by chance turn out to be useful, although only relatively few. In fact only isolated variations of this sort have proved useful and could be utilized. For example, Comrade Olenov obtained such variations in yeasts and Delone said that he got such variations in wheat.

Further, these methods helped us when applied to building of polyploids and in connection with the complex rebuilding of the nuclear system. I take these labors very seriously, since their practical effectiveness, from my point of view, is rather great. To deny this, to pass it by, as some people do here in the heat of discussion, I consider quite wrong.

But on the whole, when you think of the mass of work or read the manual of the well known geneticist, Stubbe, on the experimental production of mutations, and there is a series of other introductory works as well, when you think of all this enormous mass of work, and ask yourself, "And what concretely did it give in practice?" your answer must be that outside of that field of which I spoke, namely polyploidal rebuilding of the genome as a whole (for in this field there is a series of important achievements), the methods in question have given remarkably little to practice. It is necessary to think deeply on the question of what such methods contribute to real mastery by variations of the hereditary nature of the organism.

But has any theory given us this? Perhaps the obtaining of gene mutations has led us to a deeper explanation of the properties of the structure of the cell and its constituent elements? No, comrades, I venture to assert it has not. And those conclusions which were drawn, e.g., by Timofeev-Ressovsky and other well known geneticists, are completely false. I will return to this a little later.

It is necessary to hold fast to the main point of this problem, that is, the elaboration of methods of specific action. It is necessary to investigate the physiological causes of the mutation process. We can do this if we have a clear theoretical aim. This aim was suggested by Engels. It is included in the idea that variations of the organism derive from variations which are specific for the type of interchange of substances typical for the organism. It is necessary to vary, in a suitable way, the interchange between organism and environment, which is specific for the given species, variety and individual. Then we obtain genuine displacements. Without this, all these taps from without, all those "strokes with the stick," although they may have some sort of auxiliary significance in research, do not touch the main point. Only by proceeding by way of physiology, if you will, by way of biology of the organism, can we change it deeply and purposefully.

And a second factor, very closely connected with this: We must know, of course, how to vary the organism, when to act on a given organism--a question which in the old genetics was called the question of the sensitive period. The concept of the sensitive period has a certain indefiniteness; its significance has to be more exactly defined. It signifies that stage in the development of the organism in which a definite method of affecting irreversible changes in specific physiological interactions will be the most effective.

In this connection I want to mention the work of Michurin. Shameful things were said here of
Michurin's work by some geneticists, to the effect that Michurin was a geneticist because he applied crossing. That is nonsense, comrades! It was shameful to say such things: crossing has been applied for some thousands of years. When you speak of research, you must take the essential, the characteristic. The main motif in the work of both Michurin and Lysenko is the attempt, brilliantly realized in Michurin, now being realized in Lysenko, to modify the physiological reactions in the plant at a definite stage of its development.

And when in this connection they begin to find Lamarckism in Michurin and Lysenko--believe me, biologists know me and know that I am no lover of Lamarckism--then that seems to me a shameful stratagem. Why? Because, the only people who could find Lamarckism here are those who, even if they recognize the production of mutations by X-rays, nevertheless accept autogenesis.

Is all the rest of genetics (i.e., aside from the work of Lysenko and his school) irrelevant to the study of physiological factors in the mutation process? I think not. There is a series of works which in other ways than Michurin's and Lysenko's try to approach the analysis of the physiological factors in the mutation process. These works, of course, do not have so great a practical effectiveness as the works of Michurin and Lysenko. They approach the task from the other side and have to be brought back to the right path.

In genetics, we say, there is an extensive theory, which bears a not altogether accurate name--the theory of mutable genes. Physiological upheavals in the interchange of substances call forth unusual instability of the hereditary basis of the plant, a rebuilding in various generations, in various parts of one and the same organism. Valuable material can be derived hence.

Comrade Navashin attempted to study those physiological changes which occur when the seed ages. The young Kiev geneticist Gershenson did the following work: He tried to feed Drosophila, adding nucleic acid to the food. And he obtained hereditarily changed forms. In this case something more than an ordinary chemical was used to alter the interchange of substances. You know of course the significance of nucleic acid, and why it was used. (And there is also other work by Stubbe, Casperson, etc.)

These works lie in another plane than the works of Michurin and Lysenko. That is obvious. But the question of the physiological factors has to be tackled from all sides. Many geneticists are trying to come to grips with it, and the comrades here have to think the matter through seriously so that the experience with X-rays should not be repeated. It is necessary to consider in detail the influence of these chemical substances on the cell, on its several elements, and then to undertake experiments.

We now pass to the question of the genotype and the phenotype, the hereditary and the non-hereditary. How do I understand this question? It seems to me, comrades, that in order to avoid confusion, we ought to distinguish three distinct and basic aspects, which, however, are interrelated: First, the question of adequacy (parallel induction, Ed.), second, of the directedness of variations, and third, of the adaptive character of variations.

The first question relates to adequacy. A number of comrade geneticists contended that adequacy is impossible. In general, comrades, adequacy has been made into a bugaboo. But the question of adequacy should be raised primarily on the absolutely concrete plane. What variations are being discussed? What organism? And what character? That is what must be dealt with. We all have an insufficiently thorough historical approach to the problem of producing hereditary variations. We are inclined to evaluate on the same level, for instance, the producing of hereditary variations in wheat and in cattle. Somewhere in back of our mind lurks the thought that heredity and variability appear in various forms, and at different stages of evolution assume different expressions. But this still has to be concretized. If we are discussing, let us say, the cold-resistance of wheat, we are dealing with a plant which has a growth point. From the cells of this point of growth are formed both the body of the plant and its reproductive cells. And now let us suppose that by operating on the plant at a given stage, you obtain some irreversible variation, having a biochemical nature. The physiologists consider (with how much truth, I do not know) that raising the percentage of linoleic
acid increases resistance to cold. Let us suppose that such a variation took place as the result of action both on the somatic and the future sex cells and the point of growth were changed. The question then arises: Will the body and the sex cells be varied in a parallel and adequate manner, or not? It can happen.

We need not be frightened by adequacy. If we now ask whether sunburn on the skin of a man is reflected in his spermatozoids or not, we must recognize that here there is a different connection between the characters and the reproductive elements. In this second case, comrades—and such cases are very frequent—we cannot speak of adequacy. If we did, we would be preformationists of true Weismannian breed. This is because such adaptations as the color of a butterfly or the color of our skin are the result of a long process of individual evolution. This is a definite characteristic which came about as the result of a long process of evolution. If we think that the spermatozoa, which were differentiated earlier, and are in a different relation to the body, can directly and adequately express this variation, then that implies that in the spermatozoa there are "embryos" of this character, it implies the preformist point of view. And yet it is only in this case that we can speak of adequacy.

We need not make a bugaboo of this adequacy, but we do need to analyze the question concretely. I consider that for the great majority of characters (which are the product of a long evolution), a variation of the conditions at a given stage of development cannot adequately transform the reproductive elements. Only from the point of view of Lamarckian teleology or Weismannian preformationism would it be possible to make such an assumption. Only in isolated cases is it possible to admit such variation.

The second question is concerned with directed variation of the genotype. This is one of the issues on which classical genetics dogmatized, and hastened to declare to be forbidden ground. The conjecture, however, was made even by classical geneticists that the separate factors of heredity, having begun to vary in one direction, will mutate more often in the direction of selection. Such a statement of the issue was made, e.g., by Castle. Morgan clamped down on him for this, declaring that there was no such mutation in the direction of selection. The problem was thus buried. Jollos too approached this Question, but unsuccessfully. For what reason, is another matter. But it is interesting that he did at least try to analyze this problem for which he was later attacked by Muller. But the essence of the whole matter, comrades, is that the very problem was incorrectly stated.

It is quite obvious that the basic creative factor in directing evolution is selection. No Darwinist will deny this. But here a second question arises. The hereditary basis of the organism must vary, in the sense of the evolution of characters, in a definite direction. Without this, all our phylogenetic series lose their, so to speak, "material basis"; without this all of phylogeny hangs in the air. I believe that the problem here is to investigate the question and show the paths of possible directed variation of the organism.

Theoretically there exists a series of possible paths. If we speak of the sex cell as the starting point, then there can be a different type of variation, which gives a phenotypal directed effect. But the most important type of variation occurs when the genotype varies from A-1 to A-2, etc. The biochemical mechanism of this variation is fully conceivable. Organic chemistry gives us a hint of a way to obtain known series of substances with properties increasing in a single direction. This is a serious problem, and it is impossible to brush aside the question of the directedness of variations.

The third question concerns the nature of the rebuilding of the characters of species by adaptation. Obviously, there are three possibilities here; either the character is adaptive or non-adaptive or harmful. If we should say that the variation is always adaptive, that would be pure Lamarckism; it would be the conception of original teleology. And I personally believe that Darwin's terms, "definite" and "indefinite variability" are very important in this connection. Darwin pointed out that there is a whole series of variations, mutational variations, if you will, which he himself described, and which with respect to the adaptation of the organism may be either useful or indifferent or
harmful. Darwin pointed out that a large number of variations which arise in organisms are heritable, but indefinite in the sense of adaptation, and that only selection will give them adaptive lines.

In this connection I should like to mention the statement of the question which I find in the works of Comrades Lysenko, Prezent and others. I consider that in these works there is insufficient clarity. I have nowhere read a clear and distinct formulation of the question; there were none. Moreover, when the question of Lamarckism came up in this connection, Comrades Lysenko and Prezent dissociated themselves from it so ineffectively that much confusion remained.

Comrade Prezent states that, according to the Lamarckian conception, the organism is able to adapt itself to conditions which exceed the limits of its demands, but presumably thinks that it takes place differently. This is incorrect, inasmuch as for the vast majority of Lamarckians-Wettstein, Warming, and others--it is precisely the idea of "sliding transitions" which is characteristic, the idea of gradual displacement of the norm of reaction. On this question it is needful to dissociate oneself more clearly and precisely from the Lamarckian point of view.

Another objection is raised in this connection. Comrade Prezent, e.g., writes that according to the Lamarckian view the external goes over into the internal, diffuses in the internal. An example is adduced: when, presumably, light acts on wheat, the wheat does not reflect the character of the light ray. But no Lamarckian, unless he is hopelessly naive, will say that the plant, under the influence of light rays is transformed into a ray of light. The question is not this, but rather that the external conditions will always give a purposefully directed effect, an adaptive effect. That is the crux of the matter. Hence the criticism must of course be carried on in a different manner; a clearer, more precise formulation of the question must be given. Then our disputes in this field can be resolved.

Now if we proceed from what I have said to analyze the question of the genotype, the phenotype, the heritable and the nonheritable, then it is necessary to reconsider these conceptions in genetics. We must, as it were, break down the Chinese wall which is frequently raised between these concepts. It is quite obvious that not every somatic variation is heritable. The point is that definite somatic variations refracted through the changes going on in the interchange of substances finally become heritable under certain conditions.

How often does all this take place? Here the question must be precisely stated. Glembotzky's speech suggested an extremely interesting question to me. We, comrades, lose sight of the saying of Engels that heredity is a conservative force while variability is progressive. Of course they are interrelated. But the whole question concerns the degree of the organism's stability or instability. We must not go too far to one side or the other; we must not overestimate the degree of the organism's stability and make of its stability a sort of "limit" to variation. But in your works, Comrade Prezent, you have overestimated the degree of the organism's instability.

I believe that in this connection we have to pose a whole series of concrete problems. The attempts to vary the interchange of substances, to find the sensitive periods are very valuable. In this connection vegetative variations and hybridization constitute an extremely important, essential, and most effective method for deriving changes in the heritable nature. With the previous approach to this question, as it is so far elucidated in genetics texts, we will not go far.

In this connection I should like to make a short observation on N. I. Vavilov. You, Nikolai Ivanovich, in your speech supported the viewpoint of classical genetics that variations arising in vegetative hybridization do not change the hereditary nature of the organism. Let us for a moment ignore Michurin, Lysenko, and Alexeeva, who spoke today, but discuss the point of view of classical genetics. Even here we will find material which points to significant changes arising under vegetative hybridization. I refer to the work of Wettstein with Petunia: by means of vegetative hybridization he obtained variations of the constitution of genetically stable characters of the organism. Take the work of Kostov who is connected with your institute: he showed the emergence of gene mutations under vegetative hybridization. Thus even the material already accumulated in
classical genetics permits a different approach to these questions. Likewise, the subject of dauer-
modification (Jollos) must be subjected to detailed consideration.

Now I should like to consider the problems of the material hereditary basis of the organism.
Heredity is the reproduction and the development of the characters of preceding generations in the
offspring. It is important to state this because, unfortunately, we seem always to reduce the whole
matter to the initial stages and the end of the development of the organism, to the developed
organism and its characters, while the process of development, the all important intermediate stages,
are lost sight of.

In this connection, it seems to me, that we have to take a definite position with respect to
chromosomes and genes. The gene-theory in its present form, as accepted by many contemporary
geneticists, is extraordinarily metaphysical. But these geneticists do not like to have this said. I
believe that we have here merely a sort of modernized preformationism, denying evolution. Thus
when M. M. Zavadovsky spoke here, he said that he was not frightened by corpuscularity, by the
expression "the gene is a biological atom."

Some geneticists think that the conception of the interaction of genes, or the balance of genes, saves
the situation and helps get rid of corpuscularity. But I believe that this conception of the gene as a
biological atom is an empty conception. Genes as biological atoms do not exist. But it is clear what
they mean. Look at the work of those who take this view, Belling, for example. Belling writes
frankly that the theory of chromosomes is the theory of life, and that it is possible even to see
separate genes. We find an analogous expression in Koltzov. Finally Morgan and Muller, with their
attempt to calculate what number of genes Drosophila consists of.

From the audience: Not true.

Polyakov: How not true I remember such a calculation; how large is the number of known mutant
genes in Drosophila, and how many genes can there be in general? Am I correct?

From the audience: Correct.

Potyakov: Then why do you say it is not true?

From the audience: It is one thing to say how many genes a cell of Drosophila has, and another, of
how many genes Drosophila consists.

Polyakov: By all means, if this formulation suits you, I can accept it. But it does not alter the
situation. This leads to the attempt to split up the whole organism into chromosomes. If some
comrades support such a conception, that is their affair. I consider it untrue and unfruitful. I have in
mind the theories of the epitome, of genules, the intermediary theory of Serebrovsky and other
theories concerning the structure of the gene. Basically, they have as their starting point the idea that
if anything varies in the organism, then smash up the genes still further, into genules, sub-genes,
under-genes, etc. This is the logic which has led all the researchers working with it into a dead-end.
They invent proofs that the gene is the "unit of life," and try to portray it as an isolated molecule.

I read the article of Timofeev-Ressovsky, Delbruck and Zimmer, and even consulted on it with
physicists. The essence of this article is that a mutation is a monomolecular rebuilding of the loci of
chromosomes, and thus a variation of the gene. Thence the logical conclusion is drawn that the gene
is monomolecular or something close to it. However, even if we grant that X-rays evoke
monomolecular variations (which is not exactly proven), this tells us precisely nothing either about
the gene or its construction.

But the matter goes further. After all, comrades, it is impossible to forget that all this incorrect
statement became a philosophy of genetics, a bad philosophy of genetics. Let the geneticists come
forward and say that it is not so! Here, in Bridges' book, The Genetic Conception of Life, precisely
this idea is set forth. Muller quotes the statement that the genes arose before life, then united, etc.
These are leading investigators: Bridges, Muller. Or take Hirst, who founded a whole theory as to
how an organism is assembled from separate genes. That is a peculiar philosophy of life. We must
not lose sight of it, comrades. But if you know this, you should discuss it and criticize it. This type of metaphysical (genetic) conception of life eliminates a whole series of problems, as e.g. such questions as evolution, the correlation in the developing organism and the rather important question as to the cyclical nature of ontogenetic development. With such a metaphysical genetic conception it is inevitable that there should be a certain disdain for the problem of the external factors of development. Right here is where I look for the roots of that genetic fatalism which feeds the most reactionary tendencies. I am very far from the thought of surrendering genetics to all sorts of reactionaries, and saying that from the essence of genetics there spring racism, eugenics, and other superstitions. But we have to think through the basic theories very thoroughly and consider what they contain which can suggest such views.

Now as to the question of chromosomes. We have to call attention to a series of concepts which should be clear to us from the very beginning so that we need not return to them. We cannot speak of the chromosome as an isolated entity. It is quite obvious that variations of the chromosome or in the chromosome cannot be understood by themselves. And neither the chromosomes nor this or that chromosome locus defines the heredity of a character, but rather the interacting system of the organism as a whole.

I consider that to put the question of the influence of chromosomes in the way in which the comrades did in Vernalisation, is impossible. I remember one such formulation. The chromosome is connected with the hereditary properties and characters of the organism. It has to be studied like every other character, like, e.g., the fuzz on leaves. But the question cannot be put in this way. Fuzz on the leaves is one of many characters, but the basis of life, the base from which the organism develops, is the cell. The chromosome is the essential part of the cell, and therefore such a superficial comparison, such an analogy, does not of course solve the question and calls for deserved censure. One cannot get rid of this question so simply!

The problem is what concrete role do the chromosomes play, for they do play a definite role in the development of the organism. Comrade Kolman remarked on the table exhibited by Comrade Kerkis, which showed a correspondence between chromosomal variations and changes in definite characters. He referred to the importance of these facts and the necessity of analyzing the problems further. To me it is quite obvious that the problem here is not to split the organism up in some way into chromosomes.

Goldschmidt, unlike Muller and Morgan (and Muller does not consider him a real geneticist), does not try to engage in such a splitting-up, but tries to place the problem on a different plane. I have no time to go into the details of this theory but I may say that it appeals to me in a number of respects. I should like to emphasize that we must approach the study of the question experimentally, observe experimentally what role in the development of the organism, what role in the sense of the influence on the formation of definite properties of the organism, is played by the various parts of the cell, the chromosomal apparatus and the variation of this apparatus. This is an extremely important problem, from which we cannot escape in any case.

If you had one chromosome dropping out of the original cell from which the organism develops (as happens in the case of the sex chromosome), then the whole system, of course, develops differently. If you strike out half of a chromosome, break off a part or get it entirely out of the organism--how is that reflected at a given stage of development under given external conditions, in the development of this or that character? And here, of course, such an analysis, correctly carried out, helps us understand the essence of the process of heredity, and in a number of cases has already helped us. And I frankly state that I accept this genetic material and its great conceptual value. In many cases this helps us show the significance of definite cell structures in heredity. The most brilliant example of this is, in my opinion, that furnished by investigations of sex determination. Cytogeneticists have attained the greatest success in this field. I have cited only one example. I think that neglect of this aspect of the question can be only harmful. Is there such careless neglect among the adherents of Comrade Lysenko? I believe there is. The comrades will not deny this.
In evaluating the position of Comrade Lysenko and the other representatives of this movement, I find it impossible to agree with it. Despite all reservations, I find it very negative. In theory they have somewhere stated that the cell has an influence on heredity. But concretely—all the related facts which constitute the rational kernel of the chromosome theory and its role in the development of the characters of the organism are avoided. Here they discover a blank wall in genetics.

But this is not the case. With respect to correlation Comrade Kolman has already explained that this idea is completely wrong, that it gives us nothing. It is necessary to establish known causes (I do not fear this word)—if they are not direct causes, then through a series of mediating links it is necessary to establish causal connections in the development of the organism.

Comrade Prezent formulated the question thus: you see some kind of variation or create some variation in the structure of the chromosomal apparatus. When the organism has developed, you see a variation in the development. But post hoc is not propter hoc. Granted, that in a number of cases this may be so. In general, it is necessary to presuppose a longer history of development, a more complicated interrelation. But this question is resolved once again by experimental practice. In a whole series of cases you can evoke variations and predict the result (e.g., in connection with sex characters in various reconstructions of the chromosomal apparatus), and you can show that here post hoc after all is equal to propter hoc. I believe that the disdainful attitude toward this question can cause definite harm in practice.

Comrades Lysenko and Prezent, I do not like your attitude toward the work on polyploids, on the obtaining of amphidiploids and of thus overcoming sterility accompanying hybridization. Naturally, the lack of compatibility of the chromosomes is not the only cause of sterility. We have only to refer to Michurin in this matter. It is strange to hear the statement that fruitful hybrids arise sometimes by chance and without any experiment. But this is the very treasure-hunting which you always object to. Here you are offered a definite method which is much more effective but you run away from it when you should utilize it.

A few words on Mendelism. The solution of this question is quite clear from my attitude toward the chromosome theory of heredity. Timiryazev's evaluation of Mendelism which is many-sided and diversified, should not be exaggerated in one direction or the other. It must be comprehended, considered as a whole.

We must object to the attempt to universalize Mendelism which exists, but on the other hand, to throw Mendelism off the books and declare it pseudo-scientific I consider impossible and incorrect.

One last remark, Darwinism is much criticized today in capitalistic lands. I must say that genetics has rendered a number of services in the elaboration of evolutionary theory. But it calls for comment when our geneticists say that genetics has done a great deal for Darwinism, and at the same time say nothing of the fact that genetics has given us a number of completely incorrect conceptions leading to anti-Darwinian theories. And here we are not dealing with Heribert Nilsson who resurrected the ideas of Cuvier. To a large extent the theory of homologous series in a Batesonian sense, still persists. It is impossible to speak as you did of homologous series, Nikolai Ivanovich (Vavilov), without indicating how the anti-Darwinians use them. Last year, e.g., the book of Reinig appeared, which is based on this theory. It diverted a whole group of scientists in the direction of this false idea. He is carrying out your idea (Vavilov’s), counterposing it to Darwin's theory. Comrade Polyansky spoke of the article of Punnet. Punnet actually asserted from the Batesonian position, that the Darwinian era ended forty years ago and that the Mendelian era has begun.

If these were only reactionary phrases, they would be easy to dismiss. But the theory of mimicry, one of the strongholds of the theory of natural selection, of Darwinism, is also criticized by them from this point of view. They criticize a whole series of the most progressive tendencies in modern biology.

Comrades, take such a group of scientists as Fisher, Wright—we speak of them as Darwinian
geneticists. I have referred to Haldane as a Darwinian geneticist and I believe I shall continue to do so. But we must not only study them, but correct them. When these Darwinian geneticists employed a statistics far more interesting than those we have been discussing, when they begin to build a whole evolutionary conception on this empty, purely abiological statistics, then we can show that in the works of Haldane and the others there is no consideration of real biological interrelations, of all that is concretely involved in evolution, and much is transformed into an abstract scheme.

The struggle with all the reactionary distortions of Darwinism and with its denial by a series of geneticists is not over. We do not, and cannot brush aside such contributions of genetics as are found in the conception of evolutionary divergence, of the cytological basis of this divergence, of the role of mutations and polyploids in evolution and a number of other matters. These are genuine achievements of genetics which contemporary Darwinism must include in its system.

The editorial board in the letter which was sent us called the geneticists to solidarity. This solidarity can be attained only on the basis of Darwinism, elucidated and made deeper from the position of dialectical materialism.

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Footnotes


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Lysenko and Genetics

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Lysenko's contribution printed in the summer number of SCIENCE AND SOCIETY will certainly "give occasion to the enemy to blaspheme." I have little doubt that he has gone too far in some directions, but it is important to see what there is of value in his criticism of orthodox genetics.

He begins by attacking the theory, which appears to be taught in the Soviet Union, that once a pure line is established, selection is useless. This theory is simply false, for the following reason. A pure line originally consists of individuals all of which are homozygous and genetically alike. But in course of time this ceases to be the case as a result of mutation, and also in the case of an allopolyploid such as wheat, of crossing over between chromosomes which do not normally cross over. Hence a pure line gradually breaks up into other approximately pure lines.

Some of these will be worse from an economic point of view than the original line. But some at any rate are better adapted to local conditions than their ancestors. Hence Lysenko is quite right in stressing the importance of selecting "elite strains of seed" from so-called pure lines. Any reader who supposes that I am taking this line because Lysenko is a Communist might do worse than read a paper which I published in the Journal of Genetics for 1936, entitled "The Amount of Heterozygosis to Be Expected in an Approximately Pure Line."

His next point, the breadth of the zone of isolation needed for different crops, has nothing to do with Mendelism as such. I have of course no means of judging who is right in this controversy, but I should be prepared to bet on Lysenko's being substantially correct.

Then we come to the question of the three-to-one ratio, which Lysenko says is a statistical, not a biological regularity. I confess that I am not quite clear what he means in this case, perhaps because his speech has been summarized. Where a three-to-one ratio is expected according to the laws of formal genetics, it is very rarely obtained with complete accuracy. The deviations from it are due to two causes. First of all, we have deviations due to chance. Thus if we expect 30 hairy and ten smooth plants we are quite likely to get 33 and seven or 27 and 13. And this fact is of great biological importance. If plants or animals were always produced in exactly Mendelian ratios there would be a perpetual equilibrium in hybrid populations. These deviations, so far as they are random, are partly due to sampling, partly to linkage of the gene studied with other genes in the same chromosome affecting viability or fertility. Owing to these chance deviations, one type or another will ultimately disappear from a small population, and it will become homogeneous. Sewall Wright of Chicago has studied this effect in great detail. Second, when large numbers are grown, a deviation from the three-to-one ratio is usually found, because one type is fitter than the other. One of the largest lists of such deviations in any plant was published by de Winton and myself.[1] If there were no systematic deviations of this kind there would be no natural selection based on survival of the fittest, even if there were reproductive selection based on differences of fertility. Thus systematic deviations from the three-to-one ratio are a fact of extreme biological importance.

His next point, the importance of selection in the F₁, or first hybrid generation, is correct if the hybrids are not between pure lines. As we saw, pure lines are ideals which are rarely quite realized, and agricultural varieties may be very far from pure lines.
Next we have the question of food. I think that nine times out of ten Lysenko is wrong, that is to say that you cannot improve a breed of animals by improving its food. But there are cases where this is possible, and they may be common enough to make Lysenko's principle of great practical value. The clearest of such cases was discovered at Bar Harbor, Maine, by Little's group of workers on mouse genetics and has been specially studied by Bittner. For many years they had kept different pure lines of mice. Each line had a characteristic liability to mammary cancer in females. In one line 90 per cent of all females who did not die of some other cause before the age of two years would develop this disease, in another line only 5 per cent. The members of the immune line were no more likely to develop it if they were caged for months with the susceptible line. The liability seemed to be hereditary. But it turned out that if the young of the susceptible line were separated from their mothers at birth and suckled by immune females they were much less likely to become cancerous. And this partial immunity is handed on to their children.

Nothing of the kind has been discovered for other forms of cancer. And I believe it to be a rarer phenomenon than Lysenko supposes. But it is futile to deny its existence and to regard Lysenko's assertion of its possibility as in any way unscientific.

Now follows the question of grafting. Lysenko personally vouches for four cases where tomatoes have been altered by grafting. Tomatoes belong to the Solanaceae, which have long been known to be particularly susceptible to virus diseases. These diseases can be transmitted, among other methods, by grafting. Later research has shown that besides disease-producing viruses, it is possible to transmit viruses which have no obvious effect on the plant, but immunize it to one or more of the disease producers. Some of these viruses are known to be heavy proteins which reproduce (or are reproduced) within the plant cells. Lysenko claims to have evidence of transmissible agents which alter the shape of the fruit. It seems quite possible that the range of transmissible agents stretches from those which produce obviously pathological effects such as yellow patches on the leaves, to others which produce morphological effects like those of genes. Daniel and Dangeard in France have reported similar results in Compositae such as the Jerusalem artichoke.

On the other hand, I don't agree with Lysenko in believing that Michurin gave a white-fruited cherry red fruit by grafting it. There is a vast amount of practical experience in grafting cherries, apples, plums, loses, and other members of the Rosaceae, and no recorded case of a permanent color change. Michurin's claims to have succeeded with hybridizations which otherwise failed, as a result of grafting, are on quite a different footing. They may or may not be confirmed by workers in other countries. But so little is known about the conditions for successful hybridization that they do not seem to be a priori improbable. And in view of the great value of Lysenko's technique of vernalization, which has been amply proved not, only in the Soviet Union but all over the civilized world, I should personally be surprised if his statements on results obtained by him were not largely correct.

But scientific pioneers are not infallible. Pasteur did more for the theory and practice of fermentation than any other man. Yet he made some big mistakes. Having discovered that the usual agents of fermentation, such as yeasts and bacteria, were alive, he denied the possibility of fermentation by nonliving substances. Yet today thousands of different enzymes are known, about twenty have even been crystallized by Sumner, Northrop, and others, mostly in the U.S.A. In the same way Lysenko, who is right in pointing out that the majority of characters showing Mendelian inheritance are of little economic importance, is quite wrong in supposing that none of them are.

I take a simple example from British agricultural practice. Two dominant sex-linked genes, for barred feathers and for silver as opposed to gold feathers, show up in newly hatched chicks. Thus by a suitable cross, for example of a Light Sussex hen and a Rhode Island Red rooster, we can get chickens whose sexes can be separated at once and given different food. So long as ten years ago a single British firm was raising 800,000 chicks a year from such crosses. This was done with severely practical motives, and not to confute Lysenko. If his authority prevents similar practice in the Soviet Union he will be doing a disservice to socialism.
In the same way, I am sure that he goes much too far in his attack on the chromosome theory. His statement that "any hereditary properties can be transmitted from one breed to another even without the immediate transmission of chromosomes" is, in my opinion, absolutely false, and I think that anyone with practical experience of grafting roses or apples would agree with me. But it is equally false to say that no hereditary properties can be so transmitted. The correct statement is as above, but substituting "some" for "any."

In the same way Lysenko was wrong if he referred to the theories of current genetics, such as the three-to-one ratio and the like, as "fantasies." They are not fantasies, but approximations. Copernicus's theory that the planets went round the sun in circles was an approximation. Kepler's theory that they moved in ellipses was a better approximation. The Newton-Laplace theory was yet a better approximation, but it was still undialectical, as it did not allow for any real history of the solar system in the sense of irreversible change. Then Kant and George Darwin showed that the solar system had undergone and would undergo slow and irreversible changes through tidal friction, with not only the moon but most of the planets moving in slowly widening orbits. Various developments of the theory of relativity suggest other slow changes.

Although the Copernican and Newtonian systems were inadequate, they were great advances on the systems of Ptolemy, Kidinnu, and other earlier astronomers. And I think posterity will rank Mendel with Copernicus or Kepler, though hardly with Newton.

It must not be supposed that Lysenko stands alone in his criticism of formal genetics and his belief that breeds can be altered by feeding. Some of his views are shared, for example, by J. L. Hammond of Cambridge, England. I think that he has gone too far, but he may well have done a service to Soviet genetics by making his more traditionally minded colleagues examine not only the theoretical foundations of their work, but its relation to agricultural practice.

In the same number of SCIENCE AND SOCIETY Polyakov criticizes my mathematical work. Probably his criticism refers mainly to that summarized in The Causes of Evolution in 1930. He says that it includes "no consideration of real biological interrelations." This is largely true, because a mathematical treatment of even the simplest evolutionary problems is difficult. One must begin with problems as abstract as the motion of two perfectly elastic billiard balls on a frictionless table. I had to begin, just as mathematical physicists had to begin, by leaving out factors of great practical importance. Wright, Fisher, and others have greatly improved my work by making it more concrete. But I have also done so myself.

For example, fifteen years ago I calculated the equilibrium which should result when the same gene was constantly being produced by mutation and destroyed by natural selection. The idea of an equilibrium was undialectical, like Copernicus's idea of planetary motion in perfect and invariable circles. But it gave results of the right order of magnitude. Then Fisher pointed out that in this case selection of modifying genes would cause slow evolutionary changes in the apparent equilibrium. Later I dealt with "real biological interrelations" and showed that in civilized human populations the relaxation of inbreeding in recent centuries had probably caused a sharp decrease in the frequency of recessive abnormalities such as amaurotic idiocy, albinism, and some types of blindness. In fact the motor bus, by breaking up inbred village communities, was a powerful eugenic agent. Here, if I am correct, I am getting down to "real biological interrelations." If I were a Newton or a Maxwell, I might have got to this point in one step. I might even have done so had I been a Marxist fifteen years ago, in which case I should have been very suspicious of equilibriums, knowing that the conflict between two tendencies such as mutation and selection may lead to apparent equilibrium, but is very apt to cause real changes, either slow evolutionary changes or qualitative leaps. I might also have been on the lookout for biological effects of technical changes in transport and communications.

I have also had to bring my theories up to date in the light of the new facts discovered in the Soviet Union by Dubinin and his colleagues in their studies of wild populations of Drosophila. I had predicted some of them, but by no means all. The fact that I had predicted some of them shows that
my mathematics had a certain validity.
Any mathematical theory inevitably leaves out a good deal of relevant facts. But it is more exact
than a theory expressed in words. And I believe that my own theories, inadequate as they doubtless
are, were an essential step toward exact thinking in genetics.

Footnotes

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1. BIOLOGY, THE BASIS OF AGRONOMY

AGRONOMY deals with living bodies—plants, animals, micro-organisms. A theoretical grounding in agronomy must, therefore, include knowledge of biological laws. And the more profoundly the science of biology reveals the laws of the life and development of living bodies, the more effective is the science of agronomy.

In essence, the science of agronomy is inseparable from biology. When we speak of the theory of agronomy we mean the discovered and comprehended laws of the life and development of plants, animals, and micro-organisms.

The methodological level of biological knowledge, the state of the science treating of the laws of the life and development of vegetable and animal forms, i.e., primarily of the science known for half a century now as genetics, is of essential importance for our agricultural science.

2. THE HISTORY OF BIOLOGY: A HISTORY OF IDEOLOGICAL CONTROVERSY


The primary idea in Darwin's theory is his teaching on natural and artificial selection. Selection of variations favourable to the organism has produced the purposefulness which we observe in living nature, in the structure of organisms and their adaptation to their conditions of life. Darwin's theory of selection provided a rational explanation of the purposefulness observable in living nature. His idea of selection is scientific and true. In substance, his teaching on selection is a summation of the age-old practical experience of plant and animal breeders who, long before Darwin, produced strains of plants and breeds of animals by the empirical method.

Darwin investigated the numerous facts obtained by naturalists in living nature and analysed them through the prism of practical experience. Agricultural practice served Darwin as the material basis for the elaboration of his theory of Evolution, which explained the natural causation of the adaptation we see in the structure of the organic world. That was a great advance in the knowledge of living nature.

In Engels' opinion, three great discoveries enabled man's knowledge of the inter-connection of natural processes to advance by leaps and bounds: first, the discovery of the cell; second, the
discovery of the transformation of energy; third, "the proof which Darwin first developed in
connected form that the stock of organic products of nature surrounding us today, including
mankind, is the result of a long process of evolution from a few original unicellular germs, and that
these again have arisen from protoplasm or albumen which came into existence by chemical
means."[1]

The classics of Marxism, while fully appreciating the significance of the Darwinian theory, pointed
out the errors of which Darwin was guilty. Darwin's theory, though unquestionably materialist in its
main features, is not free from some serious errors. A major fault, for example, is the fact that, along
with the materialist principle, Darwin introduced into his theory of evolution reactionary
Malthusian ideas. In our days this major fault is being aggravated by reactionary biologists.

Darwin himself recorded the fact that he accepted the Malthusian idea. In his Autobiography we
read:

"In October 1838, that is, fifteen months after I had begun my systematic enquiry, I happened to
read for amusement Malthus on Population, and being well prepared to appreciate the struggle for
existence which everywhere goes on from long-continued observation of the habits of animals and
plants, it at once struck me that under these circumstances favourable variations would tend to be
preserved, and unfavourable ones to be destroyed. Here then I had last got a theory by which to
work." [My emphasis--T. L.]

Many are still apt to slur over Darwin's error in transferring into his teaching Malthus's preposterous
reactionary ideas on population. The true scientist cannot and must not overlook the erroneous
aspects of Darwin's teaching.

Biologists should always ponder these words of Engels: "The entire Darwinian teaching on the
struggle for existence merely transfers from society to the realm of living nature Hobbes's teaching
on bellum omnium contra omnes and the bourgeois economic teaching on competition, along with
Malthus's population theory. After this trick (the absolute justification for which I deny, particularly
in regard to Malthus's theory) has been performed, the same theories are transferred back from
organic nature to history and the claim is then made that it has been proved that they have the force
of eternal laws of human society. The childishness of this procedure is obvious, and it is not worth
while wasting words on it. But if I were to dwell on this at greater length, I should have started out
by showing that they are poor economists first, and only then that they are poor naturalists and
philosophers."[2]

For the propaganda of his reactionary ideas Malthus invented an allegedly natural law. "The cause
to which I allude ", he wrote, "is the constant tendency in all animated life to increase beyond the
nourishment prepared for it."[3]

It must be clear to any progressively thinking Darwinist that, even though Darwin accepted
Malthus's reactionary theory, it basically contradicts the materialist principle of his own teaching.
Darwin himself, as may be easily noted, being as he was a great naturalist, the founder of scientific
biology, whose activity marks an epoch in science, could not be satisfied with the Malthusian
theory, since it is, in fact and fundamentally, in contradiction to the phenomena of living nature.

Under the weight of the vast amount of biological facts accumulated by him, Darwin felt
constrained in a number of cases radically to alter the concept of the "struggle for existence ", to
stretch it to the point of declaring that it was just a figure of speech.

Darwin himself, in his day, was unable to fight free of the theoretical errors of which he was guilty.
It was the classics of Marxism that revealed those errors and pointed them out. Today there is
absolutely no justification for accepting the erroneous aspects of the Darwinian theory, those based
on Malthus's theory of overpopulation with the inference of a struggle presumably going on within
species. And it is all the more inadmissible to represent these erroneous aspects as the cornerstone
of Darwinism (as I. I. Schmalhausen, B. M. Zavadovsky, and P. M. Zhukovsky do). Such an
approach to Darwin's theory prejudices the creative development of its scientific core.

Even when Darwin's teaching first made its appearance, it became clear at once that its scientific, materialist core, its teaching concerning the evolution of living nature, was antagonistic to the idealism that reigned in biology.

Progressively thinking biologists, both in our country and abroad, saw in Darwinism the only right road to the further development of scientific biology. They took it upon themselves to defend Darwinism against the attacks of the reactionaries, with the Church at their head, and of obscurantists in science, such as Bateson.

Eminent biologists, like V. O. Kovalevsky, I. I. Mechnikov, V. M. Sechenov and particularly K. A. Timiryazev, defended and developed Darwinism with all the passion of true scientists.

K. A. Timiryazev, that great investigator, saw distinctly that only on the basis of Darwinism could the science of the life of plants and animals develop successfully, that only by further developing Darwinism and raising it to new heights was biological science capable of helping the tiller of the soil to obtain two ears of corn where only one grows today.

Darwinism as presented by Darwin contradicted idealistic philosophy, and this contradiction grew deeper with the development of its materialist teaching. Reactionary biologists have therefore done everything in their power to empty Darwinism of its materialist elements. The individual voices of progressive biologists like K. A. Timiryazev were drowned by the chorus of the anti-Darwinists, the reactionary biologists the world over.

In the post-Darwinian period the overwhelming majority of biologists--far from further developing Darwin's teaching--did all they could to debase Darwinism, to smother its scientific foundation. The most glaring manifestation of such debasement of Darwinism is to be found in the teachings of Weismann, Mendel, and Morgan, the founders of modern reactionary genetics.

3. TWO WORLDS--TWO IDEOLOGIES IN BIOLOGY

WEISMANNISM followed by Mendelism-Morganism, which made its appearance at the beginning of this century, was primarily directed against the materialist foundations of Darwin's theory of evolution.

Weismann named his conception Neo-Darwinism, but, in fact, it was a complete denial of the materialist aspects of Darwinism. It insinuated idealism and metaphysics into biology.

The materialist theory of the evolution of living nature involves recognition of the necessity of hereditary transmission of individual characteristics acquired by the organism under the conditions of its life; it is unthinkable without recognition of the inheritance of acquired characters. Weismann, however, set out to refute this materialist proposition. In his Lectures on Evolutionary Theory, he asserts that "not only is there no proof of such a form of heredity, but it is inconceivable theoretically."[4] Referring to earlier statements of his in a similar vein, he declares that "thus war was declared against Lamarck's principle of the direct effect of use and disuse and, indeed, that marked the beginning of the struggle which is going on to this day, the struggle between the Neo-Lamarckians and the Neo-Darwinians, as the contending parties are called".

Weismann, as we see, speaks of having declared war against Lamarck's principle; but it is easy enough to see that he declared war against that without which there is no materialist theory of evolution, that under the guise of "Neo-Darwinism" he declared war against the materialist foundations of Darwinism.

Weismann denied the inheritability of acquired characters and elaborated the idea of a special hereditary substance to be sought for in the nucleus. "The sought for bearer of heredity ", he stated, "is contained in the chromosome material." The chromosomes, he said, contain units, each of which "determines a definite part of the organism in its appearance and final form "."
Weismann asserts that there are "two great categories of living material: the hereditary substance, or idioplasm, and the 'nutrient substance', or trophoplasm". And he goes on to declare that the bearers of the hereditary substance, "the chromosomes, represent a separate world, as it were ", a world independent of the organism and its conditions of life.

In Weismann's opinion the living body is but a nutritive soil for the hereditary substance, which is immortal and never generated again.

Thus, he asserts, "the germ-plasm is never generated again; it only grows and multiplies continually, handed down from generation to generation.... Looked at only from the point of view of propagation, the germ-cells are the most important element in the individual specimen, for they alone preserve the species, whereas the body is reduced practically to the status of mere breeding ground for the germ-cells, the place in which they form and, under favourable conditions, feed, multiply, and ripen". The living body and its cells, according to Weismann, are but the container and nutritive medium of the hereditary substance; they themselves can never produce the latter, they "can never bring forth germ-cells ".

Weismann thus endows the mythical hereditary substance with the property of continued existence; it is a substance which does not itself develop and at the same time determines the development of the mortal body.

Further: "... the hereditary substance of the germ-cell, prior to the reduction division, potentially contains all the elements of the body ". And although Weismann does state that "in the germ-plasm there is no determinant of a' hooked nose' just as there is no determinant of the wing of a butterfly with all its parts and particles", he goes on to emphasise that, nevertheless, the germ-plasm "... contains a certain number of determinants which successively determine the development of an entire group of cells in all its stages, leading to the formation of the nose in such a mode as to result in a hooked nose, exactly in the same way as the wing of a butterfly, with all its little veins, cells, form of scales, and pigment deposits, comes into being by the successive action of multitudinous determinants upon the course of the proliferation of the cells".

Hence, according to Weismann, the hereditary substance produces no new forms, does not develop with the development of the individual, and is not subject to any dependent changes.

An immortal hereditary substance, independent of the qualitative features attending the development of the living body, directing the mortal body, but not produced by the latter--that is Weismann's frankly idealistic, essentially mystical conception, which he disguised as "Neo-Darwinism ".

Weismann's conception has been fully accepted and, we might say, carried further by the Mendelists-Morganists.

Morgan, Johannsen, and other pillars of Mendelism-Morganism, declared from the outset that they intended to investigate the phenomena of heredity independently of the Darwinian theory of evolution. Johannsen, for example, wrote in his principal work: "... one of the major aims of our research was to put an end to the harmful dependence of the heredity theories on speculations in the field of evolution". The purpose of the Morganists in making such declarations was to wind up their investigations by assertions which in the final analysis denied evolution in living nature, or recognised it as a process of purely quantitative changes.

As noted above, the controversy between the materialist and the idealist outlook in biological science has been going on throughout its history.

In the present epoch of struggle between two worlds the two opposing and antagonistic trends penetrating the foundations of nearly all branches of biology are particularly sharply defined.

Socialist agriculture, the collective and State farming system, has given rise to a Soviet biological science, founded by Michurin--a science new in principle, developing in close union with agronomic practice, as agronomic biology.
The foundations of Soviet agro-biological science were laid by Michurin and Williams, who generalised and developed the best of what science and practice had accumulated in the past. Their work has enriched our knowledge of the nature of plants and soils, our knowledge of agriculture, with much that is new in principle.

Close contact between science and the practice of collective farms and State farms creates inexhaustible opportunities for the development of theoretical knowledge, enabling us to learn ever more and more about the nature of living bodies and the soil.

It is no exaggeration to state that Morgan's feeble metaphysical "science" concerning the nature of living bodies can stand no comparison with our effective Michurinist agro-biological science.

The new vigorous trend in biology, or more truly the new Soviet biology, agro-biology, has met with strong opposition on the part of representatives of reactionary biology abroad, as well as of some scientists in our country.

The representatives of reactionary biological science--Neo-Darwinians, Weismannists, or--which is the same--Mendelist-Morganists, uphold the so-called chromosome theory of heredity.

Following Weismann, the Mendelist-Morganists contend that the chromosomes contain a special "hereditary substance" which resides in the body of the organism as if in a case and is transmitted to coming generations irrespective of the qualitative features of the body and its conditions of life. The conclusion drawn from this conception is that new tendencies and characteristics acquired by the organism under the influence of the conditions of its life and development are not inherited and can have no evolutionary significance.

According to this theory, characters acquired by vegetable and animal organisms cannot be handed down, are not inherited.

The Mendelist-Morganist theory does not include in the scientific concept "living body" the conditions of the body's life. To the Morganists, environment is only the background--indispensable, they admit--for the manifestation and operation of the various characteristics of the living body, in accordance with its heredity. They therefore hold that qualitative variations in the heredity (nature) of living bodies are entirely independent of the environment, of the conditions of life.

The representatives of Neo-Darwinism, the Mendelist-Morganists, hold that the efforts of investigators to regulate the heredity of organisms by changes in the conditions of life of these organisms are utterly unscientific. They therefore call the Michurin trend in agro-biology Neo-Lamarckian, which, in their opinion, is absolutely faulty and unscientific.

Actually, it is the other way round.

First, the well-known Lamarckian propositions, which recognise the active role of external conditions in the formation of the living body and the heredity of acquired characters, unlike the metaphysics of Neo-Darwinism (or Weismannism), are by no means faulty. On the contrary, they are quite true and scientific.

Secondly, the Michurin trend cannot be called either Neo-Lamarckian or Neo-Darwinian. It is creative Soviet Darwinism, rejecting the errors of either and free from the defects of the Darwinian theory so far as it included Malthus's erroneous ideas.

Furthermore, it cannot be denied that in the controversy that flared up between the Weismannists and Lamarckians in the beginning of the twentieth century, the Lamarckians were closer to the truth; for they defended the interests of science, whereas the Weismannists were at loggerheads with science and prone to indulge in mysticism.

The true ideological content of Morgan's genetics has been well revealed (to the discomfiture of our geneticists) by the physicist Erwin Schrödinger. In his book, *What Is Life? The Physical Aspect of the Living Cell*, he draws some philosophical conclusions from Weismann's chromosome theory, of which he speaks very approvingly. Here is his main conclusion: "...the personal self equals the
omni-present, all-comprehending, eternal self." Schroedinger regards this conclusion as "the closest a biologist can get to proving God and immortality at one stroke ".

We, the representatives of the Soviet Michurin trend, contend that inheritance of characters acquired by plants and animals in the process of their development is possible and necessary. Ivan Vladimirovich Michurin mastered these possibilities in his experiments and practical activities. The most important point is that Michurin's teaching, expounded in his works, shows every biologist the way to regulating the nature of vegetable and animal organisms, the way of altering it in a direction required for practical purposes by regulating the conditions of life, i.e., by physiological means.

A sharp controversy, which has divided biologists into two irreconcilable camps, has thus flared up over the old question: is it possible for features and characteristics acquired by vegetable and animal organisms in the course of their life to be inherited? In other words, whether qualitative variations of the nature of vegetable and animal organisms depend on the conditions of life which act upon the living body, upon the organism.

The Michurin teaching, which is in essence materialist and dialectical, proves by facts that such dependence does exist.

The Mendel-Morgan teaching, which in essence is metaphysical and idealist, denies the existence of such dependence, though it can cite no evidence to prove its point.

4. THE SCHOLASTICISM OF MENDELISM-MORGANISM

THE chromosome theory is based on Weismann's absurd proposition regarding the continuity of the germ-plasm and its independence of the soma, a proposition which K. A. Timiryazev already condemned. In line with Weismann, the Morganist-Mendelists take it for granted that parents are genetically not the progenitors of their offspring. Parents and children, according to their teaching, are brothers or sisters.

Furthermore, neither parents nor children are really themselves. All they are is by-products of the inexhaustible and immortal germ-plasm. Variations in the latter are absolutely independent of its byproduct, that is, of the body of the organism.

Let us turn to the Encyclopaedia where we naturally may expect to find the quintessence of the question under discussion.

In the 1945 edition of the Encyclopedia Americana, T. H. Morgan, one of the founders of the chromosome theory, writes in the article entitled "Heredity": "The germ-cells become later the essential parts of the ovary and testis respectively. In origin, therefore, they are independent of the rest of the body and have never been a constituent part of it.... Evolution is germinal in origin and not somatic as had been earlier taught. [My emphasis--T. L.] This idea of the origin of new characters is held almost universally today by biologists."

The same idea differently worded is propounded in the same Encyclopedia Americana by Professor Castle in the article on "Genetics ". After stating that usually the organism develops from a fertilised egg, Castle goes on to set forth the "scientific" foundations of genetics as follows:

"In reality the parent does not produce the child nor even the reproductive cell which functions in its origin. The parent is himself merely a by-product of the fertilised egg (or zygote) out of which he arose. The direct product of the zygote is other reproductive cells, similar to those from which it arose. ... Hence heredity (that is, the resemblance between parent and child) depends upon the close connection between the reproductive cells which formed the parent and those which formed the child, one being the immediate and direct product of the other. This principle of the 'continuity of the germinal substance' (reproductive cell material) is one of the foundation principles of genetics. It shows why body changes produced in a parent by environmental influences are not inherited by
the offspring. It is because offspring are not the product of the parent's body but only of the
germinal substance which that body harbours....To August Weismann belongs the credit for first
making this clear. He may thus be regarded as one of the founders of genetics."

It is clear to us that the foundation principles of Mendelism-Morganism are false. They do not
reflect the actuality of living nature and are an example of metaphysics and idealism.

Because this is so obvious, the Mendelist-Morganists of the Soviet Union, though actually fully
sharing the principles of Mendelism-Morganism, often conceal them shamefacedly, veil them,
disguise their metaphysics and idealism with verbal trimmings. They do this because of their fear of
being ridiculed by Soviet readers and audiences firm in the knowledge that the germs of organisms,
or the sexual cells, are a result of the vital activity of the parent organisms.

It is only when no mention is made of the fundamentals of Mendelism-Morganism that persons
having no detailed knowledge of the life and development of plants and animals can be led to think
of the chromosome theory of heredity as a neat system, as in some degree corresponding to the
truth. But once we accept the absolutely true and generally known proposition that the reproductive
cells, or the germs, of new organisms are produced by the organism, by its body, and not by the very
same reproductive cell from which the given, already mature, organism arose, nothing is left of the
"neat" chromosome theory of heredity.

Naturally, what has been said above does not imply that we deny the biological role and
significance of chromosomes in the development of the cells and of the organism. But it is not at all
the role which the Morganists attribute to the chromosomes.

Plenty of examples can be cited to show that our home-grown Mendelist-Morganists accept in its
entirety the chromosome theory of heredity, its Weismannist foundations and idealistic conclusions.

Academician N. K. Koltzov, for example, asserts: "Chemically, the genoneme with its genes
remains unchanged in the course of the entire ovogenesis and is not subject to metabolism--
oxidising and restorative processes."[6] This assertion, which no literate biologist can accept, denies
the existence of metabolism in a section of the living developing cells. It must be obvious to
everyone that N. K. Koltzov's conclusion is fully in line with the Weismannist and Morganist
idealist metaphysics.

N. K. Koltzov's wrong assertion dates back to 1938. It has long since been exposed by the
Michurinists, and it would, perhaps, not have been worth while going back to the past if not for the
fact that the Morganists persist in holding on to their anti-scientific positions to this day.

We can find further proof of this by turning once mere to Schroedinger's book mentioned above.
Schroedinger says in substance the same things as Koltzov. Since he shares the idealistic conception
of the Morganists, he also asserts that there exists an " hereditary substance " which is " capable of
withstanding for long periods the disturbing influence of hear motion...." [My emphasis -T. L.]

The Russian translator of Schroedinger's book, A. A. Malinovsky (a scientific worker in N. P.
Dubinin's laboratory), in his "Postscript" to the said book, subscribes--and with good reason--to
Haldane's opinion, linking Schroedinger's idea with N. K. Koltzov's views.

In that " Postscript", written in 1947, Malinovsky says: "The view accepted by Schroedinger,
according to which the chromosome is a gigantic molecule (Schroedinger's 'aperiodic crystal'), was
first put forward by the Soviet biologist, Prof. N. K. Koltzov, and not by Delbruck, with whose
name Schroedinger associates this conception."

There is no point, in this case, in going into the question of who is entitled to claim credit for the
authorship of this scholastic view. A more important point is the high appreciation of Schroedinger's
book by one of our home-grown Morganists, A. A. Malinovsky.

Here are a few samples of the praise he showers on this book: "In a fascinating form, accessible
both to the physicist and the biologist, Schroedinger reveals to the reader a new trend rapidly
developing in science, a trend largely combining the methods of physics and of biology."

"Strictly speaking, Schroedinger's book represents the first coherent results of this trend.... 
Schroedinger makes a big contribution of his own to this new trend in the science of life, and this 
quite justifies the enthusiastic opinions voiced about his book in the foreign scientific press."

Since I am no physicist, I shall say nothing concerning the methods of physics which Schroedinger 
combines with biology. As for the biology in Schroedinger's book, it is Morganist pure and simple 
and this, in fact, is what makes Malinovsky go into raptures over it.

The enthusiastic praise of Schroedinger's book in Malinovsky's "Postscript" speaks eloquently 
enough of our Morganists' idealistic views and positions.

M. M. Zavadovsky, Professor of Biology in the University of Moscow, writes in an article entitled "The Creative Road of Thomas Hunt Morgan": "Weismann's ideas found a wide response among 
biologists, and many of them have taken the road suggested by that highly gifted investigator ... 
Thomas Hunt Morgan was one of those who highly appreciated the main content of Weismann's 
ideas."[7]

Now what "main content" is meant here?

What is meant is an idea of prime importance to Weismann and all Mendelist-Morganists, including 
Prof. M. M. Zavadovsky. The latter formulates that idea as follows: "What came first, the hen's egg 
or the hen? And", writes Professor Zavadovsky, "to the question posed thus sharply Weismann gave 
an explicit, categorical reply: the egg."

It is obvious to anyone that both the question and the answer which Professor Zavadovsky, 
following Weismann, gives are nothing but a revival, and a belated one at that, of old scholasticism.

In 1947 Professor M. M. Zavadovsky repeats and defends the ideas he set forth in 1931 in his work 
*Dynamics of Development of Organisms*. There M. M. Zavadovsky considered it necessary to 
"firmly join with Nussbaum who maintains that sexual products do not develop from the maternal 
organism, but from the same source as the latter", that "the seminal corpuscles and eggs do not 
orinate in the parent organism, but have a common origin with the latter". And in his "General 
Conclusion" Professor Zavadovsky wrote: "Analysis leads us to the conclusion that the cells of the 
germ track cannot be regarded as products of somatic tissue. The germ cells and the cells of the 
soma should be regarded not as daughter and parent generations, but as twin sisters, of which one 
(the soma) is the feeder, protector, and guardian of the other."

The geneticist, N. P. Dubinin, Professor of Biology, wrote in his article, "Genetics and Neo-
Lamarckism": "Genetics quite rightly divides the organism into two distinct sections--the hereditary 
plasm and the soma. More, this division is one of its foundation principles, one of its major 
generalisations."[8]

We need not continue the list of such authors as M. M. Zavadovsky and N. P. Dubinin, who frankly 
expound the ABC of the Morganist system. In college text-books on genetics this ABC is called the 
"Mendelian laws" (dominance, division, purity of gametes, etc.).

An example of how uncritically our Mendelist-Morganists accept idealistic genetics is the fact that 
the standard text-book on genetics in many of our colleges has until quite recently been a translated 
American text-book, by Sinnott and Dunn.

Fully in line with the main theses of that text-book, Prof. N. P. Dubinin wrote in that same article of 
his ("Genetics and Neo-Lamarckism"): "Thus the facts of modern genetics rule out any recognition 
of the 'foundation of foundations' of Lamarckism--the idea that acquired characters are 
inhaerited."[9] [My emphasis-T. L.]

The Mendelist-Morganists have thus thrown overboard one of the greatest acquisitions in the 
history of biological science--the principle of the inheritance of acquired characters.
To the materialist teaching that it is possible for plants and animals to inherit individual variations of characters acquired under the influence of conditions of life, Mendelism-Morganism opposes an idealistic assertion, dividing the living body into two separate substances: the mortal body (or soma) and an immortal hereditary substance, germ-plasm. It is further categorically maintained that changes in the soma, i.e., in the living body, have no effect whatever upon the hereditary substance.

**5. THE IDEA OF UNKNOWABILITY IN THE TEACHING ON "HEREDITARY SUBSTANCE"

MENDELISM-MORGANISM endows the postulated mythical "hereditary substance" with an indefinite character of variation. Mutations, i.e., changes of the "hereditary substance", are supposed to have no definite tendency. This assertion of the Morganists is logically connected with the underlying basis of Mendelism-Morganism—the principle that the hereditary substance is independent of the living body and its conditions of life.

The Morganist-Mendelists, who proclaim that hereditary alterations, or "mutations" as they are called, are "indefinite", presume that such alterations *cannot as a matter of principle be predicted*. We have here a peculiar conception of unknowability; its name is idealism in biology.

The assertion that variation is "indefinite" raises a barrier to scientific foresight, thereby disarming practical agriculture.

Proceeding from the unscientific and reactionary Morganist teaching concerning "indefinite variation", the head of the chair of Darwinism at the University of Moscow, Academician I. I Schmalhausen, asserts in his *Factors of Evolution* that hereditary variation, in its specific features, does not depend on the of life and therefore has no definite tendency.

"Factors unassimilated by the organism", writes Schmalhausen, "if they reach the organism at all and influence it, can have but an indefinite effect....Such influence can only be indefinite. Consequently, all new alterations in the organism, which as yet have no past history, will be indefinite. This category of alterations will include, however, not only mutations as new 'hereditary' changes, but any new (i.e., appearing for the first time) modification."[10]

On a preceding page in the same book Schmalhausen writes: "In the development of any individual environmental factors perform, in the main, only the role of agents liberating the course of certain form-producing processes and the conditions which make it possible to consummate their realisation."[11]

This formalistic, autonomistic theory of a "liberating cause" in which the role of external conditions is reduced to the realisation of an autonomous process, has long been demolished by the advance of progressive science; it has been exposed by materialism as unscientific, as in essence idealistic.

Schmalhausen and others among our home-grown followers of imported Morganism claim that what they are asserting Darwin said before them. In proclaiming the "indefiniteness of variation", they invoke Darwin's statements on the subject. Darwin indeed spoke of "indefinite variation". But that was due to the *limitations* of selection practice in his days. Darwin was aware of that himself and wrote that there were at that time no means of explaining the causes or nature of variation in organic beings. That, he said, was an obscure matter.

The Mendelist-Morganists cling to everything that is obsolete and wrong in Darwin's teaching, at the same time discarding its living materialist core.

In our Socialist country, the teaching of the great transformer of nature, I. V. Michurin, has created a fundamentally new basis for directing the variability of living organisms.

Michurin himself and his followers have obtained and are obtaining directed hereditary changes in
vegetable organisms literally in immense quantities. Yet Schmalhausen still asserts that:
"The appearance of individual mutations is by all indications a case of chance phenomena. We can neither predict nor deliberately induce this or that mutation. So far it has been found impossible to establish any reasonable connection between the quality of mutation and definite changes in the factors of the environment."[12]

On the basis of the Morganist conception of mutations, Schmalhausen has formulated the theory of so-called "stabilising selection" --a theory profoundly wrong ideologically and having a disarming effect upon practical activity. According to Schmalhausen, the formation of breeds and strains proceeds--presumably inevitably--in a receding curve: the formation of breeds and strains, stormy at the dawn of civilisation, increasingly expends its "reserve of mutations" and gradually recedes. "Both the formation of breeds of domestic animals and the formation of strains of cultivated plants", writes Schmalhausen, "proceeded with such exceptional speed mainly, apparently, because of the previously accumulated reserve of variability. Further strictly directed selection is slower...."[13]

Schmalhausen's assertion and his entire conception of "stabilising selection" follow the Morgan line.

As we know, Michurin, in the course of his lifetime, produced more than three hundred new strains of plants. Many of them were produced without sexual hybridisation, and all of them were the result of strictly directed selection, including systematic training. It is an insult to progressive science to assert--in face of these facts and subsequent achievements of followers of Michurin's teaching--that strictly directed selection must progressively recede.

Schmalhausen obviously finds that Michurin's facts do not fit in with his theory of "stabilizing selection". In his book, Factors of Evolution, he gets out of the difficulty by making no mention of these works of Michurin or of the very existence of Michurin as a scientist. Schmalhausen has written a bulky volume on factors of evolution without ever once mentioning--not even in his bibliography--either K. A. Timiryazev or I. V. Michurin. Yet Timiryazev bequeathed to Soviet science a remarkable theoretical work bearing practically the same title: Factors of Organic Evolution. As for Michurin and the Michurinists, they have put the factors of evolution to work for agriculture, revealed new factors and given us a deeper understanding of the old ones.

Schmalhausen has "forgotten" the Soviet advanced scientists, the founders of Soviet biological science. But at the same time he quotes profusely and repeatedly statements of big and small foreign and home-grown representatives of Morgan's metaphysics and leaders of reactionary biology. That is the style of Academician Schmalhausen, who calls himself a "Darwinist". Yet at a meeting of the Faculty of Biology at the University of Moscow his book was recommended as a masterpiece in the creative development of Darwinism. The book has been given a high rating by the deans of the Faculties of Biology at the Universities of Moscow and Leningrad; it has been praised by I. Polyakov, Professor of Darwinism at the University of Kharkov, by the Pro-Rector of the University of Leningrad, Y. Poliansky, by the member of our Academy, B. Zavadovsky, and by other Morganists who sometimes pose as orthodox Darwinists.

6. THE STERILITY OF MORGANISM-MENDELEISM

THE Morganist-Weismannists, i.e., the adherents of the chromosome theory of heredity, have repeatedly asserted--without grounds whatever and often in a slanderous manner--that I, as President of the Academy of Agricultural Sciences, have used my office in the interests of the Michurin trend in science, which I share, to suppress the other trend, the one opposed to Michurin's. Unfortunately, it has so far been exactly the other way round, and it is of that that I, as President of the All-Union Academy of Agricultural Sciences, may and should be accused. I have been wanting in strength and ability to make proper use of my official position to create conditions for the more extensive development of the Michurin trend in the various divisions of biological science, and to
restrict, if only somewhat, the scholastics and metaphysicians of the opposite trend. As a matter of fact, therefore, the trend so far suppressed--suppressed by the Morganists--happens to be the one which the President represents, namely, the Michurin trend.

We, the Michurinists, must squarely admit that we have hitherto proved unable to make the most of the splendid possibilities created in our country by the Party and the Government for the complete exposure of the Morganist metaphysics, which is in its entirety an importation from foreign reactionary biology hostile to us. It is now up to the Academy, to which a large number of Michurinists have just been elected, to tackle this major task. This will be of considerable importance in the matter of training forces and providing more scientific aid to collective farms and state farms.

Morganism-Mendelism (the chromosome theory of heredity) is to this day taught, in a number of versions, in all colleges of biology and agronomy, whereas the study of Michurin genetics has in fact not been introduced at all. In the higher official scientific circles of biologists, too, the followers of the teaching of Michurin and Williams have often found themselves in the minority. They were a minority in the Lenin All-Union Academy of Agricultural Sciences, too. But the condition in the Academy has now sharply changed thanks to the interest taken in it by the Party, the Government, and Comrade Stalin personally. A considerable number of Michurinists have been elected members and corresponding members of our Academy, and more will be added shortly; at the coming elections. This will create a new situation in the Academy and new opportunities for the further development of the Michurin teaching.

The assertion that the chromosome theory of heredity, with its underlying metaphysics and idealism, has hitherto been suppressed, is entirely wrong. The very opposite is the truth.

In our country the Morganist cytogeneticists find themselves confronted by the practical effectiveness of the Michurin trend in agrobiological science.

Aware of the practical worthlessness of the theoretical postulates of their metaphysical "science", and reluctant to give them up and to accept the vigorous Michurin trend, the Morganists have bent all their efforts to check the development of the Michurin trend which is inherently opposed to their pseudo-science.

It is a calumny to assert that somebody has been preventing the cytogenetic trend in biological science from associating itself with practical agriculture in our country. There is no truth whatever in the assertions to the effect that "the right to the practical application of the fruits of their labours has been a monopoly of Academician Lysenko and his followers".

The Ministry of Agriculture might tell us exactly what the cytogeneticists have offered for practical application, and, if there have been such offers, whether they were accepted or rejected.

The Ministry of Agriculture might also tell us which of its scientific-research institutes (to say nothing of colleges) have not engaged in cytogenetics in general and, particularly, in the polyploidy of plants obtained by the application of colchicine.

I know that many institutes have been engaged and are engaged in this sort of activity which, in my view, is little productive. More, the Ministry of Agriculture set up a special institution, headed by A. R. Zhebrak, to study questions of polyploidy. I think that this institution, though it has for some years done nothing besides its work on polyploidy, has produced literally nothing of practical value.

Here is one example which might be cited to show how useless is the practical and theoretical programme of our domestic Morganist cytogeneticists.

Professor of Genetics, N. P. Dubinin, Corresponding Member of the Academy of Sciences of the U.S.S.R., who is regarded by our Morganists as the most eminent among them, has worked for many years to establish the differences in the cell nuclei of fruit flies in urban and rural localities.

For the sake of complete clarity, let us mention the following. What Dubinin is investigating is not
qualitative alterations--in this case, in the nucleus of the cell--resulting from the action of qualitatively differing conditions of life. What he is studying is not the inheritance of characteristics acquired by fruit flies under the influence of definite conditions of life, but changes, recognisable in the chromosomes, in the make-up of the population of these flies as the result of the simple destruction of a part of them, for one thing, during the war. Dubinin and other Morganists call such destruction "selection". Such sort of "selection" identical with an ordinary sieve, which has nothing in common with the truly creative role of selection, is the subject of Dubinin's investigations.

His work is entitled: "Structural Variability of Chromosomes in Populations of Urban and Rural Localities."

Here are a few quotations from it:

"During the study of individual populations of *D. funebris* in the work of 1937 the fact was noted that there were noticeable differences as regards concentration of inversions. Tinyakov stressed this phenomenon on the basis of extensive material. However, only the 1944-45 analysis has shown us that these substantial differences are due to the differences of conditions of habitation in town and in countryside.

"The population of Moscow has eight different orders of genes. In the second chromosome there are four orders (one standard and three different inversions). One inversion in the III chromosome and one in IV ... Inv. II--1 has its limits from 23 C to 31 B. Inv. II--2, from 29 A to 32 B. Inv. II--3, from 32 B to 34 C. Inv. III--I, from 50 A to 56 A. Inv. IV--1, from 67 C to 73 A/B. In the course of 1943-45 the karyotype of 3,315 individuals in the population of Moscow was studied. The population contained immense concentrations of inversions, which proved to be different in various sections of Moscow."

Dubinin went on with his investigations during and after the war and studied the problem of the fruit flies in the city of Voronezh and its environs. He writes:

"The destruction of industrial centres during the war upset the normal conditions of life. The drosophila populations found themselves in severe conditions of existence which, possibly, surpassed the severity of wintering in rural localities. It would be of profound interest to study the influence of the changes in the conditions of existence caused by the war upon the karyotypical structure of urban populations. In the spring of 1945 we studied populations from the city of Voronezh, one of those that suffered the worst destruction as the result of the German invasion. Among 225 individuals only two flies were found to be heterozygotal for inversion II--2 (0.88 per cent). Thus the concentration of inversions in this large city proved to be lower than in rural localities. We see here the disastrous action of natural selection upon the karyotypical structure of the population."

Dubinin, as we see, writes so that on the surface his work may appear to some to be even scientific. As a matter of fact, this was one of the main works on the basis of which Dubinin was elected Corresponding Member of the Academy of Sciences of the U.S.S.R.

But if we were to put it all in plainer terms, stripping it of the pseudo-scientific verbiage and replacing the Morganist jargon with ordinary Russian words, we would arrive at the following:

As the result of many years of effort Dubinin "enriched" science with the "discovery" that during the war there occurred among the fruit-fly population of the city of Voronezh and its environs an increase in the percentage of flies with certain chromosome structures and a decrease in the percentage of dies with other chromosome structures (in the Morganist jargon that is called "concentration of inversions " II--2).

Dubinin is not content with these "highly valuable" discoveries from the theoretical and practical standpoint, which he made during the war. He sets himself further tasks for the period of recovery. He writes:

"It will be very interesting to study in the course of several coming years the restoration of the
karyotypical structure of the urban population in connection with the restoration of normal conditions of life."

That is typical of the Morganists' "contribution" to science and practical activity before the war and during the war, and such are the vistas of the Morganist "science " for the period of recovery!

7. MICHURIN'S TEACHING, FOUNDATION OF SCIENTIFIC BIOLOGY

Contrary to Mendelism-Morganism, with its assertion that the causes of variation in the nature of organisms are unknowable and its denial of the possibility of directed changes in the nature of plants and animals, I. V. Michurin's motto, was: "We must not wait for favours from Nature; our task is to wrest them from her."

His studies and investigations led I. V. Michurin to the following important conclusion: "It is possible, with man's intervention, to force any form of animal or plant to change more quickly and in a direction desirable to man. There opens before man a broad field of activity most useful for him."

The Michurin teaching flatly rejects the fundamental principle of Mendelism-Morganism that heredity is completely independent of the plants' or animals' conditions of life. The Michurin teaching does not recognise the existence in the organism of a separate hereditary substance which is independent of the body. Changes in the heredity of an organism or in the heredity of any part of its body are the result of changes in the living body itself. And changes of the living body occur as the result of departure from the normal in the type of assimilation and dissimilation, of departure from the normal in the type of metabolism. Changes in organisms or in their separate organs or characters may not always, or not fully, be transmitted to the offspring, but changed germs of newly generated organisms always occur only as the result of changes in the body of the parent organism as the result of direct or indirect action of the conditions of life upon the development of the organism or its separate parts, among them the sexual or vegetative germs. Changes in heredity, acquisition of new characters and their augmentation and accumulation in successive generations are always determined by the organism's conditions of life. Heredity changes and increases in complexity as the result of the accumulation of new characters and properties acquired by organisms in successive generations.

The organism and the conditions required for its life are an inseparable unity. Different living bodies require different environmental conditions for their development. By studying these requirements we come to know the qualitative features of the nature of organisms, the qualitative features of heredity. Heredity is the property of a living body to require definite conditions for its life and development and to respond in a definite way to various conditions.

Knowledge of the natural requirements of an organism and its response to external conditions makes it possible to direct the life and development of the organism. By regulating the conditions of life and development of plants and animals we can penetrate their nature ever more deeply and thus establish what are the means of changing it in the required direction. Once we know the means of regulating development we can change the heredity of organisms in a definite direction.

Each living body builds itself out of the conditions of its environment in its own fashion, according to its heredity. That is why different organisms live and develop in the same environment. As a rule, each given generation of a plant or animal develops largely in the same way as its predecessors, particularly its close predecessors. Reproduction of beings similar to itself is the general characteristic of every living body.

When an organism finds in its environment the conditions suitable to its heredity, its development proceeds in the same way as it proceeded in previous generations. When, however, organisms do not find the conditions they require and are forced to assimilate environmental conditions which, to
some degree or other, do not accord with their nature, then the organisms or parts of their bodies become more or less different from the preceding generation. If the altered section of the body is the starting point for the new generation, the latter will, to some extent or other, differ from the preceding generations in its requirements and nature.

The cause of changes in the nature of a living body is a change in the type of assimilation, in the type of metabolism. For example, the vernalisation (yarovisation) of spring cereals does not require lowered temperatures. Normally it proceeds in temperatures such as obtain in the spring and summer in the fields. But by using lower temperature conditions in the vernalisation of spring cereals it is possible, after two or three generations, to turn them into winter cereals. And winter cereals require lowered temperatures for their vernalisation. Here is a concrete example showing how a new requirement is induced in the offspring of the plants under discussion—the requirement for lowered temperatures as a condition for vernalisation.

Sexual cells and any other cells through which organisms propagate are produced as the result of the development of the whole organism, by means of metabolism and transformation. The stages in the evolution of an organism are accumulated, as it were, in the cells from which the new generation originates.

We may therefore say that to the extent that in the new generation the body of an organism (a plant, say) is built anew there also develop all its characters, including heredity.

In one and the same organism the development of various cells and their separate parts, the development of individual processes, requires different external conditions. Besides, these conditions are assimilated in different ways. It should be stressed that in this case we mean by external that which is assimilated, and by internal that which assimilates.

The life of an organism proceeds through innumerable correlated processes and transformations. The food that enters the organism from the external environment undergoes a series of transformations whereby it is assimilated by the living body, changing from external to internal. This internal, since it is living matter, enters into metabolic relations with the substances of other cells and particles of the body, feeding them and thus becoming external with regard to them.

Two kinds of qualitative changes are observed in the development of vegetable organisms.

1. Changes connected with the process of the realisation of the individual cycle of development, when natural requirements, i.e., heredity, are normally met by the corresponding external conditions. The result is a body of the same breed and heredity as the preceding generations.

2. Changes of nature, i.e., changes in heredity. Such changes are also the result of individual development, but deviating from the normal, usual process. Changes in heredity are as a rule the result of the organism's development under external conditions which, to some extent or other, do not correspond to the natural requirements of the given organic form.

Changes in the conditions of life bring about changes in the type of development of vegetable organisms. A changed type of development is thus the primary cause of changes in heredity. All organisms which cannot change in accordance with the changed conditions of life do not survive, leave no progeny.

Organisms, and hence also their nature, are created only in the process of evolution. Of course, a living body may undergo an alteration also outside the evolutionary process (a burn, a break in joints, tearing of roots, etc.), but such alterations will not be characteristic or necessary for the vital process.

Numerous facts go to show that changes in various sections of the body of a vegetable or animal organism are not fixed by the reproductive cells with the same frequency or to the same extent.

This is explained by the fact that the process of development of each organ, of each particle of the living body, requires relatively definite external conditions. These conditions are selected from the
environment by the development of each organ and minutest part of an organ. Therefore, if a section of the body of a vegetable organism is forced to assimilate conditions relatively unusual for it and as a result undergoes alteration and becomes different from the analogous section of the body in the preceding generation, the substances which it sends forth to neighbouring cells may not be selected by the latter, may not be joined into the further chain of corresponding processes. Of course, there will still be a connection between the altered section of the vegetable organism and the other sections of the body, for otherwise it could not exist at all; but this connection may not be fully reciprocal. The altered section of the body will be receiving this or that food from the neighbouring sections; but it will not be able to give away its own specific substances, because the neighbouring sections will refuse to select them.

This explains the frequently observed phenomenon when altered organs, characters, or properties of an organism do not appear in the progeny. But the altered sections of the body of the parent organism always possess an altered heredity. Horticulturists have long known these facts. An altered twig or bud of a fruit tree or the eye (bud) of a potato tuber cannot as a rule influence the heredity of the offspring of the given tree or tuber which are not directly generated from the altered sections of the parent organism. If, however, the altered section is cut away and grown separately as an independent plant, the latter, as a rule, will possess a changed heredity, the one that characterised the altered section of the parent body.

The extent of hereditary transmission of alterations depends on the extent to which the substances of the altered section of the body join in the process which leads to the formation of reproductive sexual or vegetative cells.

Once we know how the heredity of an organism is built up, we can change it in a definite direction by creating definite conditions at a definite moment in the development of the organism.

Good strains of plants or breeds of animals are always produced by the application of proper methods of cultivation or breeding. No good strains can ever be produced by poor methods of cultivation, and in many cases even good strains will deteriorate under such conditions after a few generations. It is a basic rule in seed growing that plants grown for seed must be tended with the utmost care. They must be provided with conditions meeting the optimum of the hereditary requirements of the given plants. Of well-cultivated plants the very best are selected for seed. That is the way strains of plants are improved in practice. Under poor cultivation, no selection of the best plants for seed will produce the required results. Under poor cultivation all the seeds obtained are poor, and the best among them are still poor.

According to the chromosome theory of heredity, hybrids can only be produced by sexual reproduction. That theory denies the possibility of obtaining vegetative hybrids, for it denies that the conditions of life have any specific influence upon the nature of plants. I. V. Michurin not only recognised the possibility of producing vegetative hybrids, but elaborated the "mentor" method. This method consists in the following: by grafting scions (twigs) of old strains of fruit trees on the branches of a young strain, the latter acquires properties which it lacks, these properties being transmitted to it through the grafted twigs of the old strain. That is why I. V. Michurin called this method "mentor". The stock is also to used as a mentor. By this method Michurin produced or improved a number of new good strains.

I. V. Michurin and the Michurinists have found methods of obtaining vegetative hybrids in large quantities.

The vegetative hybrids cogently prove that Michurin's conception of heredity is correct. At the same time they represent an insuperable obstacle to the theory of the Mendelist-Morganists.

When grafted, organisms which have not reached the stage of full formation, i.e.: have not completed their cycle of development, will always change their development as compared with the plants which have their own roots. In the union of plants by means of grafting the product is a single organism with varying strains, that of the stock and that of the scion. By planting the seeds from the
stock or the scion it is possible to obtain offspring, individual representatives of which will possess
the characteristics not only of the strain from which the seed has been taken, but also of the other
with which it has been united by grafting.

Obviously, the scion and the stock could not have exchanged chromosomes of the cell nuclei; yet
inherited characters have been transmitted from stock to scion and vice versa. Consequently, the
plastic substances produced by the stock and the scion, just as the chromosomes, and just as any
particle of the living body, possess the characters of the strain, are endowed with definite heredity.

Any character may be transmitted from one strain to another by means of grafting as well as by the
sexual method.

The wealth of factual material concerning vegetative transmission of various characters of potatoes,
tomatoes, and a number of other plants leads us to the conclusion that vegetative hybrids do not
differ in principle from sexual hybrids.

The representatives of Mendel-Mogan genetics are not only unable to obtain alterations of heredity
in a definite direction, but categorically deny that it is possible to change heredity so as adequately
to meet environmental conditions. The principles of Michurin's teaching, on the other hand, tell us
that we can change heredity so as fully to meet the effect of the action of conditions of life.

A case in point is the experiments to convert spring forms of bread grains into winter forms, and
winter forms into still harder ones in regions of Siberia, for example, where the winters are severe.
These experiments are not only of theoretical interest. They are of considerable practical value for
the production of frost-resistant strains. We already have winter forms of wheat obtained from
spring forms, which are not inferior, as regards frost-resistance, to the most frost-resistant strains
known in practical farming. Some are even superior.

Many experiments show that when an old-established kind of heredity is being eliminated, we do
not at once get a fully established, solidified new heredity. In the vast majority of cases what we get
is an organism with a plastic nature, which I. V. Michurin called "shaken".

Vegetable organisms with a "shaken" nature are those in which their conservatism has been
eliminated, and their selectivity with regard to external conditions is weakened. Instead of
conservative heredity, such plants preserve, or there appears in them, only a tendency to show some
preference for certain conditions.

The nature of a vegetable organism may be shaken:
1. By grafting, i.e., by uniting the tissues of plants of different varieties;
2. By bringing external conditions to bear upon them at definite moments, when the organism
undergoes this or that process of its development;
3. By cross-breeding, particularly of forms sharply differing in habitat or origin.

The best biologists, first and foremost I. V. Michurin, have devoted a great deal of attention to the
practical value of vegetable organisms with shaken heredity. Plastic vegetable forms with
unestablished heredity, obtained by any of the enumerated methods, should be further bred from
generation to generation in those conditions, the requirement of which, or adaptability to which, we
want to induce and perpetuate in the given organisms.

In most vegetable and animal forms new generations develop only after fertilisation--the fusion of
female and male reproductive cells. The biological significance of the process of fertilisation is that
thereby organisms are produced with dual heredity--maternal and paternal. Dual heredity lends
vitality to organisms and widens the range of their adaptability to varying conditions of life.

It is the usefulness of enriching heredity that determines the biological necessity for cross-breeding
forms differing from each other even if ever so slightly.

The renovation and strengthening of the vitality of vegetable forms may take place also by the
vegetative, asexual method. It is brought about by the living body assimilating new external conditions, conditions unusual for it. In experiments in vegetative hybridisation with the aim of producing spring forms out of winter forms or vice versa, and in a number of other cases of the nature of organisms becoming shaken, we may observe the renovation and strengthening of the vitality of organisms.

By regulating external conditions, the conditions of life, of vegetable organisms, we can change strains in a definite direction and create strains with desirable heredity.

_Heredity is the effect of the concentration of the action of external conditions assimilated by the organism in a series of preceding generations._

By means of skilful hybridisation, by the method of sexual conjugation of breeds, it is possible at once to unite in one organism that which has been assimilated and solidified in the crossed breeds by many generations. But, according to Michurin's teaching, no hybridisation will produce the desired results, unless the conditions are created which will promote the development of the characters which we want the newly bred or improved strain to inherit.

I have here propounded Michurin's teaching in most general outline. The important point that must be stressed here is that it is absolutely necessary for all Soviet biologists to make a profound study of this teaching. The best way for scientific workers in various departments of biology to master the theoretical depths of the Michurin teaching is to study Michurin's works, to read them over again and again, and to analyse some of them with a view to solving problems of practical importance.

Socialist agriculture stands in need of a developed, profound biological theory which will help us quickly and properly to perfect the methods of cultivating plants and obtaining plentiful and stable crop yields. It stands in need of a profound biological theory which will help workers in agriculture to obtain in a short time the highly productive strains of plants they need to correspond to the high fertility which the collective farmers are creating on their fields.

Unity of theory and practice--that is the right highroad for Soviet science. The Michurin teaching is the one that best embodies this unity in biological science.

In my speeches and writings I have cited numerous examples of the application of the Michurin teaching to solve questions of practical importance in various departments of plant breeding. Here I shall take the liberty to dwell briefly on some questions of animal breeding.

As in the case of vegetable forms, the forming of animals is closely linked with their conditions of life, with the conditions of their environment.

The basis for increasing the productivity of domestic animals, for improving existing breeds and producing new ones, is their food and the conditions in which they are kept. This is particularly important if the effectiveness of cross-breeding is to be heightened. Various breeds of domestic animals have been and are produced by men for various purposes and under various conditions. Each breed therefore requires its own conditions of life, those that contributed to its formation.

The greater the divergences between the biological properties of a breed and the conditions of life provided for the individual animals, the less will be the economic value of the given breed.

For example, the advantages--from an economic standpoint--of rich pastures and good feeding with succulent and concentrated fodders are smaller in the case of cattle which by nature cannot give much milk than in the case of cattle with high milking capacities. The former breed thus obviously does not, in the economic respect, come up to the conditions provided for it. Such a breed should be improved by cross-breeding so as to adjust it to the conditions of feeding and maintenance.

On the other hand, a breed noted for its milk-yielding properties, when placed in conditions of poor feeding and maintenance, will not only fail to live up to its reputation as a milk producer, but its chances of survival will be diminished. In such cases the conditions of feeding and maintenance should be improved so as to adjust them to the breed.
Our science and practice of animal breeding, in line with the state plan for obtaining produce in the required quantities and of proper quality, must be guided by the principle: to select and improve breeds in accordance with the conditions of feeding, maintenance and climate, and at the same time to create conditions of feeding and maintenance most suitable to the given breeds.

The principal method of constantly improving breeds is to select pedigreed animals best suited for the required aim and at the same time to improve the conditions of feeding and maintenance that are most conducive to the development of the animals in the desired direction.

Cross-breeding is a radical and quick method of changing breeds, that is to say, the progeny of the given animals.

In cross-breeding we get, as it were, a union of two breeds evolved by man in the course of a long period of time by creating various conditions of life for the animals. But the nature (heredity) of crosses, particularly in the first generation, is usually unstable, easily responding to the action of the conditions of life, feeding, and maintenance.

Therefore, in cross-breeding it is of especial importance, in choosing a breed for the improvement of a local breed, to bear in mind the conditions of feeding, maintenance, and climate. At the same time, in order to develop the characters and properties which we want to induce by cross-breeding, we must provide conditions of feeding and maintenance conducive to the development of the new improving properties; otherwise, we may fail to establish the desired qualities and the breed may even lose some of its good qualities.

I have given an example of the application of the general principles of the Michurin teaching to animal husbandry to show that Soviet Michurin genetics, revealing as it does the general laws of the development of living bodies in order to cope with problems of practical importance, is also applicable to stockbreeding.

When we speak of mastering the teaching of Michurin we also mean the development and deepening of this teaching, the development of scientific biology. That is the line along which we must secure the growth of the forces of our Michurin biologists so as to provide increasing scientific assistance to the collective farms and State farms in coping with the tasks set by the Party and the Government.

8. YOUNG SOVIET BIOLOGISTS SHOULD STUDY THE MICHRIN TEACHING

UNFORTUNATELY, the Michurin teaching is not so far taught in our universities and colleges. We Michurinists are greatly to blame for this. But it will be no mistake to say that it is also the fault of the Ministry of Agriculture and the Ministry of Higher Education.

To this day Morganism-Mendelism is taught in the majority of our universities and colleges in the chairs of genetics and selection, and in many cases also in the chairs of Darwinism, whereas the Michurin teaching, the Michurin trend in science, fostered by the Bolshevik Party and by Soviet reality, remains in the shade.

The same may be said of the position with regard to the training of young scientists. By way of illustration, we shall cite the following. In an article "On Doctors' Theses and the Responsibility of Opponents," printed in issue No. 4 of the Vestnik Vysshoy Shkoly ("Higher Education Messenger") for 1945, Academician P. M. Zhukovsky, who is the Chairman of the Biology Experts' Commission under the Highest Committee on Academic Degrees, wrote: "A deplorable situation has developed in the matter of theses on genetics. Theses on genetics are very rare; they represent, in fact, solitary instances. This is to be explained by the abnormal relations, which have assumed the character of hostility, between the adherents of the chromosome theory of heredity and its opponents. The truth of the matter is that the former somewhat fear the latter, who are very aggressive in their polemics.
It would be better to put an end to this situation. Neither the Party nor the Government forbid the chromosome theory of heredity, and it is freely propounded in universities and colleges. Let the controversy go on." (p. 30.)

Let us first note that P. M. Zhukovsky confirms that the chromosome theory of heredity is freely taught in universities and colleges. That is true. But he wants more: he wants Mendelism-Morganism to be still more widely propounded. He wants us to have many more Mendelist-Morganist Masters and Doctors of Science who would still more extensively propagate Mendelism-Morganism in our universities and colleges. That, in fact, is what Academician Zhukovsky is driving at in a large section of his article, and that reflects his general line as Chairman of the Biological Commission.

No wonder therefore that the Commission put up all sorts of obstacles in the case of theses on genetics whose authors attempted, even if ever so timidly, to develop this or that principle of Michurin genetics. On the other hand, theses by Morganists, enjoying P. M. Zhukovsky's encouragement, appeared and were passed on favourably not at all so rarely--in any event, much oftener than the interests of true science required. True enough, theses with a Morganist tendency appeared more rarely than Academician P. M. Zhukovsky would have liked. But there are reasons for this. Under the influence of the Michurin criticism of Morganism young scientists with an insight into questions of philosophy have in recent years come to realise that the Morganist views are utterly alien to the world outlook of Soviet people. In this light the position of Academician P. M. Zhukovsky does not look so good, seeing that he advises young biologists to pay no heed to the Michurinists' criticism of Morganism, but to go on developing the latter.

Soviet biologists are right when they are suspicious of the Morganist views and refuse to listen to the scholasticism of the chromosome theory. They stand to gain, always and in everything, if they will ponder more often on what Michurin said of this very scholasticism.

I. V. Michurin held that Mendelism "..... contradicts the truth of nature, before which no artful structure reared out of wrongly understood phenomena can stand up". "What I would like", he wrote, "is that the thinking unbiased observer should stop at this and personally test the truth of these conclusions; they represent a basis which we bequeath to naturalists of coming centuries and millenniums."[17]

### 9. FOR A CREATIVE SCIENTIFIC BIOLOGY

I. V. MICHURIN laid the foundations for the science of regulating the nature of plants. These foundations have wrought a change in the very method of thinking in dealing with problems of biology.

A knowledge of *causal* connections is essential for the practical work of regulating the development of cultivated plants and domestic animals. For biological science to be in a position to render the collective farms and State farms ever more assistance in obtaining higher crop yields, higher yields of milk, etc., it must comprehend the complex biological inter-relations, the laws of the life and development of plants and animals.

*A scientific handling of practical problems is the surest way to a deeper knowledge of the laws of development of living nature.*

Biologists have paid very little attention to the study of the interrelations, the natural-historical connections that exist between individual bodies, individual phenomena, parts of individual bodies and links of individual phenomena. Yet only these connections, inter-relations, and natural interactions enable us to understand the process of development, the essence of biological phenomena.

But when living nature is studied in isolation from practical activity the scientific principle of the study of biological connections is lost.
The Michurinists, in their investigations, take the Darwinian theory of evolution as their basis. But in itself Darwin's theory is absolutely insufficient for dealing with the practical problems of Socialist agriculture. That is why the basis of contemporary Soviet agro-biology is Darwinism transformed in the light of the teaching of Michurin and Williams and thereby converted into Soviet creative Darwinism.

Many problems of Darwinism assume a different aspect as the result of the development of our Soviet agro-biological science, of the Michurin trend in agro-biology. Darwinism has not only been purified of its deficiencies and errors and raised to a higher level, but—in a number of its principles—has undergone a considerable change. From a science which primarily explains the past history of the organic world, it is becoming a creative, effective means of systematically mastering living nature, making it serve practical requirements.

Our Soviet Michurinist Darwinism is a creative Darwinism which poses and solves problems of the theory of evolution in a new way, in the light of Michurin's teaching.

I cannot in this report touch on many of the theoretical problems of great practical significance. I shall dwell briefly on only one of them—namely, the question of intra- and inter-specific relations in living nature.

The time has come to take a different view of the question of the formation of species, approaching it from the angle of the transition of quantitative accumulation into qualitative distinctions.

We must realise that the formation of a species is a transition—in the course of historical process—from quantitative to qualitative variations. Such a leap is prepared by the vital activity of organic forms themselves, as the result of quantitative accumulations of responses to the action of definite conditions of life, and that is something that can definitely be studied and directed.

Such an understanding of the formation of species, an understanding of its natural laws, places in the hands of biologists a powerful means of regulating the vital process itself and consequently also the formation of species.

I think that in posing the question this way we make take it for granted that what leads to the formation of a new specific form, to the formation of a new species out of an old one, is not the accumulation of quantitative distinctions by which varieties within a species are usually recognised. The quantitative accumulations of variations which lead to the change from an old form of species to a new form are variations of a different order.

Species are not an abstraction, but actually existing links in the general biological chain.

Living nature is a biological chain separated, as it were, into individual links or species. It is therefore wrong to say that a species does not retain the constancy of its qualitative definiteness as a species for any length of time. To insist on that would be to regard the evolution of living nature as proceeding as if along a plane, without any leaps.

I am confirmed in this opinion by the data of experiments for the conversion of hard wheat (durum) into soft (vulgare).

Let me note that all systematists admit that these are good, unquestionable, independent species.

We know that there are no true winter forms among hard wheats, and that is why in all regions with a relatively severe winter hard wheat is cultivated only as a spring, not a winter, crop. Michurinists have mastered a good method of converting spring into winter wheat. It has already been mentioned that many spring wheats have been experimentally converted into winter wheat. But all of those belonged to the species of soft wheat. When experiments were started to convert hard wheat into winter wheat it was found that after two, three or four years of autumn planting (required to turn a spring into a winter crop) durum becomes vulgare, that is to say, one species is converted into another. Durum, i.e., a hard 28-chromosome wheat, is converted into several varieties of soft 42-chromosome wheat; nor do we, in this case, find any transitional forms between the durum and
vulgare species. *The conversion of one species into another takes place by a leap.*

We thus see that the formation of a new species is prepared by altered vital activity under definite new conditions in a number of generations. In our case it is necessary to bring autumn and winter conditions to bear on hard wheat in the course of two, three or four generations. Then it can change by a leap into soft wheat without any transitional form between the two species.

I think that it may be pertinent to note that what led me to study profoundly theoretical problems, such as the problem of species or of intra-specific and inter-specific relations among individuals, was never mere curiosity or a fondness for abstract theorising. I was and am led to study these questions of theory by my work in the course of which I have to find answers to thoroughly practical problems. For a correct understanding of the relations among individuals within species it was necessary to have a clear idea of the qualitative distinctions of intra-specific and inter-specific varieties of forms.

It thus became possible to find new solutions to such problems of practical importance as the combating of weeds in farming, or the choosing of grasses for the sowing of grass mixtures, or the fast and extensive afforestation of steppe areas, and many others.

That is what led me to make a new study of the problem of intra- and inter-specific struggle and competition, and after a deep and comprehensive investigation I have come to the conclusion that there exists no intra-specific struggle but mutual assistance among individuals within a species, and there does exist inter-specific struggle and competition and also mutual assistance between different species. I regret that I have so far done very little to elucidate the theoretical content and practical significance of these questions in the press.

I am coming to the end. Now, Comrades, as regards the theoretical line in biology, Soviet biologists hold that the Michurin principles are the only scientific principles. The Weismannists and their followers, who deny the heritability of acquired characters, are not worth dwelling on at too great length. The future belongs to Michurin.

V. I. Lenin and J. V. Stalin discovered I. V. Michurin and made his teaching the possession of the Soviet people. By their great paternal attention to his work they saved for biology the remarkable Michurin teaching. The Party, the Government, and J. V. Stalin personally, have taken an unflagging interest in the further development of the Michurin teaching. There is no more honourable task for us Soviet biologists than to develop creatively Michurin's teaching and to follow in all our activities Michurin's style in the investigation of the nature of the evolution of living beings.

Our Academy must work to develop the Michurin teaching. In this it ought to follow the personal example of interest in the activity of I. V. Michurin shown by our great teachers--V. I. Lenin and J. V. Stalin.

**CONCLUDING REMARKS**

BEFORE I pass on to my concluding remarks I consider it my duty to make the following statement.

The question is asked in one of the notes handed to me, What is the attitude of the Central Committee of the Party to my report? I answer: The Central Committee of the Party examined my report and approved it.

I shall now take up some of the points brought out at our session. The adherents of the so-called chromosome theory of heredity who spoke here denied that they were Weismannists and all but proclaimed themselves antagonists of Weismann. On the other hand, it has been clearly shown in my report and in many of the speeches of representatives of the Michurin trend that Weismannism and the chromosome theory of heredity are one and the same thing, Mendelist-Morganists abroad make no secret of this. In my report I quoted articles by Morgan and Castle published in 1945, in
which it is plainly stated that the so-called teaching of Weismann is the basis of the chromosome theory of heredity. By Weismannism (which is the same as idealism in biology) is meant any conception of heredity which takes for granted the division of the living body into two substances which are different in principle: the usual living body, presumably possessing no heredity but subject to variations and transformations, that is to say, to development; and a special hereditary substance, presumably independent of the living body and not subject to development under the influence of the conditions of life of the ordinary living body, or the soma. That much is beyond any doubt. No efforts of the advocates of the chromosome theory of heredity, both those who spoke and those who did not speak at the session, to lend their theory a materialist appearance can change the character of this theory, which is essentially idealistic.

The Michurin trend in biology is a materialist trend, because it does not separate heredity from the living body and the conditions of its life. There is no living body without heredity, and there is no heredity without a living body. The living body and its conditions of life are inseparable. Deprive an organism of its conditions of life and its living body will die. The Morganists, however, maintain that heredity is isolated, something apart from the mortal living body, from what they call the soma.

Those are the principles on which we differ with the Weismannists. And connected with them is also our difference on a question which has a long history behind it, namely, the question of inheritance of characters acquired by plants and animals. The Michurinists say that inheritance of acquired characters is possible and necessary. This principle has once more been fully confirmed by the abundant factual material demonstrated at this session. Morganists, among them those who spoke at our session, cannot comprehend this principle so long as they have not fully discarded their Weismannist notions.

Some of them still find it hard to accept the idea that heredity is inherent not only in the chromosomes, but in any particle of the living body. They therefore want to see with their own eyes cases of hereditary properties and characters transmitted from generation to generation without the transmission of chromosomes.

These questions, so incomprehensible to the Morganists, can best be answered by demonstrating and explaining the experiments in vegetative hybridisation carried on extensively in our country. It was I. V. Michurin who elaborated vegetative hybridisation. And experiments in vegetative hybridisation show incontrovertibly that heredity is a property not only of the chromosomes, but of every living thing, any cells and any particles of the body. For heredity is determined by the specific type of metabolism. You need but change the type of metabolism in a living body to bring about a change in heredity.

Academician P. M. Zhukovsky, as becomes a Mendelist-Morganist, cannot conceive transmission of hereditary properties without transmission of chromosomes. He cannot conceive that the ordinary living body possesses heredity. In his view, that is the property of the chromosomes only. He therefore does not think it possible to obtain plant hybrids by means of grafting, he does not think it possible for plants and animals to inherit acquired characters. I promised Academician Zhukovsky to show him vegetative hybrids, and I have now the pleasure of demonstrating them at this session.

In this case one of the participating plants was a strain of tomatoes with leaves not pinnate, as usual, but like those of the potato. Its fruits are red and oblong in shape.

The other strain that participated in the grafting was one with the usual pinnate tomato leaves. The fruits when ripe are not red, but yellowish white.

The strain with the potato leaves was used as the stock, and the strain with the pinnate leaves was the scion.

In the year when the graft was made no changes were observed either in the scion or in the stock. Seeds were gathered from the fruits that had grown up on the scion and from those that had grown up on the stock. These seeds were then planted.
Most of the plants that grew up from the seeds taken from the fruits of the stock did not differ from the initial strain, that is to say, they were with potato leaves and their fruits were red and oblong in shape. Six plants, however, had pinnate leaves, and some of them had yellow fruits, that is to say, both the leaves and the fruits had changed under the influence of the other strain, the one which had been the scion.

Academician P. M. Zhukovsky has expressed doubt as to the purity of the experiments in vegetative hybridisation, pointing out that cross-pollination of the strains might have occurred—in other words, that it was a case of sexual hybridisation. But how, Comrade Zhukovsky, can the results of the experiments I demonstrate be explained by cross-pollination?

All who have had anything to do with the hybridisation of tomatoes know that when the plants with pinnate leaves and yellow fruits are cross-pollinated with the plants with potato leaves and red fruits, the first generation will invariably have pinnate leaves but red fruits.

But see what we have got in our experiments. The leaves are indeed pinnate, but the fruits are not red but yellow. How, then can these results be explained by accidental cross-pollination.

Here are the fruits of some others of these vegetative hybrids. The leaves are also pinnate, but of the ripe fruits on the stalk, one, as you see, is red and the other yellow. Variety within a single plant is a quite frequent phenomenon among vegetative hybrids. It should be borne in mind that vegetative hybridisation is not the usual mode of the union of strains, not the one that has developed in the course of their evolution. That is why as the result of grafting we often get organisms that are shaken and therefore prone to vary.

It is not in all plants by any means that we can observe easily perceptible alterations in the year of the grafting or even in the first seed generation. None the less we already have every ground to assert that every graft of a plant in its youthful stage produces changes in heredity. To prove this point we are going on with our work on vegetative hybrids of tomatoes at the Institute of Genetics of the Academy of Sciences of the U.S.S.R.

I shall now show you plants of the second seed generation obtained from the same graft; but these are from seeds taken from plants which gave no perceptible alterations in the first seed generation. On a number of plants from the second seed generation the leaves are changed—they are not like potato leaves in appearance, but pinnate, and the fruits are yellow. In this case, too, there is no reason to doubt the purity of the work or to suspect cross-pollination. In the first generation these plants had potato leaves and red fruits. If the pinnate leaves in the plants of the second generation are the result of cross-pollination, why are the fruits not red but yellow?

We thus see that as the result of grafts we obtain directed, adequate alterations; we obtain plants combining the characters of the strains joined in the grafting, that is to say, we get true hybrids. New formations are also observed. For example, among the progeny of the same graft there are plants that have borne small fruits, like those of uncultivated forms. But we all know that in the case of sexual hybridisation, too, we observe, besides the transmission to the progeny of characters of the parent forms, also the appearance of new forms.

I could cite many more cases of the production of vegetative hybrids. It is no exaggeration to say that there are hundreds and thousand of them in our country. The Michurinists not only understand how vegetative hybrids are produced, but produce them in large numbers from numerous varieties.

I have dwelt at length on vegetative hybrids because they provide instructive material of great significance. For not only Mendelists but even materialists who have not seen vegetative hybrids, may refuse to believe that anything that is alive, any particle of a living body, possesses heredity as well as the chromosomes. This can be easily demonstrated by the examples of vegetative hybridization. Chromosomes cannot be transferred from stock to scion and vice versa—that is a fact no one disputes. Yet hereditary properties, such as the colouring of the fruit, its shape, the shape of the leaves, and others, are transmitted from scion to stock and from stock to scion. Now show us
any properties of two breeds blended into one by means of sexual hybridisation--in the case of tomatoes, for instance--which could not be blended or have not been blended by the Michurinists, by means of vegetative hybridisation.

Thus experiments in vegetative hybridisation provide unmistakable proof that any particle of a living body, even the juices exchanged between scion and stock, possesses hereditary qualities. Does this detract from the role of the chromosomes? Not in the least, Is heredity transmitted through the chromosomes in the sexual process? Of course it is.

We recognise the chromosomes. We do not deny their presence. But we do not recognise the chromosome theory of heredity. We do not recognise Mendelism-Morganism.

Let me remind you that Academician P. M. Zhukovsky promised that if I showed him vegetative hybrids, he would believe and revise his position. I have now kept my promise to show him vegetative hybrids. But I must remark, firstly, that dozens and hundreds of such hybrids could be seen in our country for at least a decade now; and, secondly, is it possible that Academician Zhukovsky, a botanist, does not know what is known to many, even if not all, horticulturists--namely, that in decorative horticulture a great deal has been done, and is being done, to change the heredity of plants by means of grafting?

Some of the Morganists who spoke at this session alleged that, together with the chromosome theory of heredity, Lysenko and his followers reject all the experimental facts obtained by Mendelist-Morganist science. Such allegations are wrong. We do not reject any experimental facts, and this holds good for the facts concerning chromosomes.

Some go so far as to assert that the Michurin trend denies the action upon plants of factors producing mutations, such as X-rays, colchicine, etc. But how is it possible to assert anything of the sort? Certainly, we Michurinists cannot deny the action of such factors. We recognise the action of the conditions of life upon the living body. Why then should we refuse to recognise the action of such potent factors as X-rays or a strong poison like colchicine, etc.? We do not deny the action of substances which produce mutations. But we insist that such action, which penetrates the organism not in the course of its development, not through the process of assimilation and dissimilation, can only rarely and only fortuitously lead to results useful for agriculture. It is not the road of systematic selection, not the road of progressive science.

The numerous and lengthy efforts made in the Soviet Union to produce polyploid plants with the aid of colchicine and similar potent factors have in no way led to the results so widely advertised by the Morganists.

A great deal has been said and written to the effect that geranium began to give seeds after its chromosome outfit had been increased. But this geranium is not being grown for the market, and I, as a scientist, venture the opinion that it never will be so grown, because it is much more practical to propagate geranium by cuttings. Currants, for example, Can be grown from seeds, but in practice they are propagated by cuttings. Potatoes can also be grown from seeds, but it is more practical to plant tubers. As a rule, plants which can be propagated both by seeds and by cuttings (i.e., by the vegetative method) are propagated for practical ends by the latter method.

This does not mean that we minimize the importance of the fact that a geranium has been obtained which is capable of producing seeds. If not for practical ends, this form can be of use in the study of plant breeding.

And what I have said of geranium applies also to mint.

What other polyploids are often represented by the Morganist as highly important achievements? Wheat, millet, buckwheat, and a few other plants. But, according to the statements which we have heard here from the Morganists themselves (A. R. Zhebrak, for example), all these polyploids--wheat, millet, buckwheat--have so far, as a rule, been found to be of small fertility, and their authors themselves have refrained from recommending their cultivation for practical ends.
There only remains the tetraploid kok-saghyz. This is the first year it is being tested on collective farms. It goes without saying that, if it proves to be good, it ought to be introduced in practical farming. So far, however, according to the data of three years' testing at Government experimental stations, it is not superior to the ordinary diploid strains, such as Bugakov's, for example. This is the first year tetraploid kok-saghyz is being tested on collective farms. In another two or three years we shall have practical proof of how good it is. I sincerely hope that it may prove to be the best of all kok-saghyz strains. The country can only gain thereby.

At the same time we must not forget that among the strains of cultivated plants there are plenty of polyploids whose origin not only has nothing to do with colchicine and the theory of the production of mutations, but the entire theory of Morganism-Mendelism has no bearing whatever on it. For centuries people did not know that many good strains of pears, for example, are polyploids. But we have also as many equally good strains of pears which are not polyploid. These facts alone provide enough grounds for the conclusion that it is not the number of chromosomes that determines the quality of a strain.

There are good and bad strains of hard 28-chromosome wheat, and there are good and bad strains of soft 42-chromosome wheat. Is it not obvious that breeding must be conducted, not with a view to the number of chromosomes, not with a view to polyploidy, but with a view to inducing good qualities and properties?

When a good strain has been produced, we can also determine the number of its chromosomes. But no one, certainly, will think of discarding a good strain only because it has turned out to be a polyploid or not a polyploid. No Michurinist, no serious-minded person generally, can approach the question from such an angle.

Our Morganists, among them some who spoke at this session, in order to adduce proof that their theory is effective, often point to some strains of bread grains which are widespread in practical farming, as, for example, lutescens 062, melanopus 069, and some other strains of long standing which they claim have been produced on the basis of Morganism-Mendelism. But actually Mendelism has nothing to do with the production of these strains. How, for example, have strains like lutescens 062, melanopus 069, ukrainka, and some others been produced? They were produced by the ancient method of selection from local strains.

I shall quote here Prof. S. I. Zhegalov, who wrote in his work, An Introduction to the Selection of Agricultural Plants: "Under ordinary farming conditions we have to deal, not with pure forms, but with 'strains' representing more or less complex combinations of various forms.... The first, perhaps, to draw attention to this fact in the first quarter of the nineteenth century [long before the appearance of Weismannism - T. L.] was the Spanish botanist Mariano Lagasca, who published his observations in Spanish. There is an interesting story extant about a visit he paid to his friend, Colonel Le Couteur, at the latter's estate on Jersey Island. During an inspection of the fields he drew the attention of his host to the considerable divergence of forms among the plants and suggested that individual forms selected for further pure breeding. The idea appealed to Le Couteur who selected twenty-three different forms and began to test relative merits. As a result of the tests, he found one of the forms to be the very best, and in 1830 put it on the market as a new strain named Talavera de Bellevue. Since then this kind of work has been tried many times, and it has led to the production of variable strains. In substance, it consists in separating the initial mixtures into their component parts. That is why this method is known as 'analytical selection'. At present it is the principal method employed in work with self-pollinating plants and is systematically applied by all stations, particularly in the early stages of the work on plants formerly little affected by selection."[18]

A little farther Prof. S. I. Zhegalov writes: "The method of analytical selection lends meaning to an aphorism credited to Jordan: 'To obtain a new strain we must first possess it'.[19]

Comrade Shehurdin, was the form of wheat now called lutescens 062 to be found among the native
"Poltavka" strain or not? [Voice from the audience: "Yes, positively."] The same is true of the forms called ukrainka and melanopus 069.

That is why S. I. Zhegalov accepts the aphorism that in applying the method of analytical selection it is necessary, when we want to produce a new strain, first to possess it. The named strains, to which our Mendelists usually point, have indeed been obtained in this manner.

We Michurinists, however, cannot agree with Prof. S. I. Zhegalov and his interpretation of Darwinian selection. For it is possible to begin to select plants with scarcely perceptible and still feeble useful characters, in order to reinforce and develop these useful characters by repeated selection and proper cultivation. But, as is obvious to any one, the described Darwinian method of selection has no bearing whatever on the Mendel-Morganist theories.

It should be mentioned that formerly strains were bred only on the basis of the above method. For that matter, this method is being applied today and will be applied in future. It is useful, and practical breeders who successfully apply it should be appreciated and encouraged.

Far from rejecting the method of continuous improving selection, we, as is well known, have always insisted on it. Morganists, on the other hand, have ridiculed the application of repeated improving selections in practical seed growing.

Weismannism-Morganism has never been, nor can it be, a science conducive to the systematic production of new forms of plants and animals.

It is significant that abroad, in the United States for example, which is the home of Morganism and where it is so highly extolled as a theory, this teaching, because of its inadequacy, has no room in practical farming. Morganism as a theory is being developed per se, while practical farmers go their own way.

Weismannism-Morganism does not reveal the real laws of living nature; on the contrary, since it is a thoroughly idealistic teaching, it creates an absolutely false idea about natural laws.

For instance, the Weismannist conception that the hereditary characteristics of an organism are independent of environmental conditions has led scientists to affirm that the property of heredity (i.e., the specific nature of an organism) is subject only to chance. All the so-called laws of Mendelism-Morganism are based entirely on the idea of chance.

Here are a few examples.

"Gene" mutations, according to the theory of Mendelism-Morganism, appear fortuitously. Chromosome mutations are also fortuitous. Due to this, the direction of the process of mutation is also fortuitous. Proceeding from these invented fortuities, the Morganists base their experiments too on a fortuitous choice of substances that might act as mutation factors, believing that they are thereby acting on their postulated hereditary substance, which is just a figment of their imagination, and hoping to obtain fortuitously what may by chance prove to be of use.

According to Morganism, the separation of the so-called maternal and paternal chromosomes at reduction division is also a matter of pure chance. Fertilisation, according to Morganism, does not occur selectively, but by the chance meeting of germ cells. Hence the splitting of characters in the hybrid progeny is also a matter of chance, etc.

According to this sort of "science" the development of an organism does not proceed on the basis of the selectivity of conditions of life from the environment, but again on the basis of the assimilation of substances fortuitously entering from without.

On the whole, living nature appears to the Morganists as a medley of fortuitous, isolated phenomena, without any necessary connections and subject to no laws. Chance reigns supreme.

Unable to reveal the laws of living nature, the Morganists have to resort to the theory of probabilities, and, since they fail to grasp the concrete content of biological processes, they reduce
biological science to mere statistics. It is not for nothing that statisticians, like Galton, Pearson, and latterly Fisher and Wright, are also regarded as founders of Mendelism-Morganism. Probably, that is also the reason why Academician Nemchinov has told us here that, as a statistician, he had no difficulty in mastering the chromosome theory of heredity.

Mendelism-Morganism is built entirely on chance; this "science" therefore denies the existence of necessary relationships in living nature and condemns practical workers to fruitless waiting. There is no effectiveness in such a science. With such a science it is impossible to plan, to work toward a definite goal; it rules out scientific foresight.

*A science which fails to give practical workers a clear perspective, the power of finding their bearings and confidence that they can achieve practical aims does not deserve to be called science.*

Physics and chemistry have been rid of fortuities. That is why they have become exact sciences.

Living nature has been developing and is developing on the basis of strict laws inherent in it. Organisms and species develop in line with natural necessities inherent in them.

*By ridding our science of Mendelism-Morganism-Weismannism we will expel fortuities from biological science.* We must firmly remember that science is the enemy of chance. That is why Michurin, who was a transformer of nature, put forward the slogan: "We must not wait for favours [i.e., lucky chances--T.L.] from nature; our task is to wrest them from her."

Aware of the practical sterility of their theory, the Morganists do not even believe in the possibility of the existence of an effective biological theory. Ignorant even of the ABC of the Michurinist science, they cannot to this day imagine that for the first time in the history of biology a truly effective theory has come into being--the Michurin teaching.

A great deal can be scientifically predicted on the basis of the Michurin teaching, thus freeing practical plant breeders to an ever-increasing extent from the elements of chance in their work. Michurin himself elaborated his theory, his teaching, only in the process of solving problems of practical importance, in the process of the production of good strains. That is why the Michurin teaching is, by its very spirit, inseparable from practical activity.

Our system of collective farming and our socialist agriculture created the conditions for the flowering of the Michurin teaching. Let us recall Michurin's words: "In the person of the collective farmer the history of agriculture of all times and all nations has an entirely new type of farmer, one who has joined issue with the elements marvellously armed technically and acting on nature as a man with the aims of a renovator."[20]

"I see", wrote I. V. Michurin, "that the system of collective farming, by means of which the Communist Party is inaugurating the great work of renovating the land, will lead labouring humanity to real power over the forces of nature.

The great future of our entire natural science is in the collective farms and state farms."[21]

The Michurin teaching is inseparable from the practical collective farm and State farm activity. It is the best form of unity of theory and practice in agricultural science.

It is clear to us that the Michurian movement could not extensively develop, if there were no collective farms and State farms.

Without the Soviet system I. V. Michurin would have been, as he himself wrote, "an obscure hermit of experimental horticulture in Tsarist Russia "[22]

The strength of the Michurin teaching lies in its close association with the collective farms and State farms, in the fact that it elucidates profoundly theoretical problems by solving important practical problems of socialist agriculture.

Comrades, our session is drawing to its close. This session has vividly demonstrated the strength
and potency of the Michurian teaching. Many hundreds of representatives of biological and agricultural science have taken part in it.

They have come here from all parts of our vast country. They have taken a lively interest in the discussion on the situation in biological science and, convinced in the course of many years of practical activity that the Michurin teaching is right, are ardently supporting this trend in biological science.

The present session has demonstrated the complete triumph of the Michurin trend over Morganism-Mendelism.

It is truly a historic landmark in the development of biological science.

I think I shall not be wrong if I say that this session has been a great occasion for all workers in the sciences of biology and agriculture.

The Party and the Government are showing paternal concern for the strengthening and development of the Michurin trend in our science, for the removal of all obstacles to its further progress. This imposes upon us the duty to work still more extensively and profoundly to arm the State farms and collective farms with an advanced scientific theory. That is what the Soviet people expect of us.

We must effectively place science, theory, at the service of the people, so that crop yields and the productivity of stock-breeding may increase at a still more rapid pace, that labour on State farms and collective farms may be more efficient.

I call upon all Academicians, scientific workers, agronomists, and animal breeders to bend all their efforts and work in close unity with the foremost men and women in socialist farming to achieve these great and noble aims.

Progressive biological science owes it to the geniuses of mankind, Lenin and Stalin, that the teaching of I. V. Michurin has been added to the treasure-house of our knowledge, has become part of the gold fund of our science.

Long live the Michurin teaching, which shows how to transform living nature for the benefit of the Soviet people!

Long live the Party of Lenin and Stalin, which discovered Michurin for the world and created all the conditions for the progress of advanced materialist biology in our country.

Glory to the great friend and protagonist of science, our leader and teacher, Comrade Stalin!

Footnotes

[4] All quotations from Weismann are retranslations from the 1905 Russian edition of Lectures on Evolutionary Theory--IV.
[8] Natural Science and Marxism (Russian), 1929, No. 4, p. 83.
[9] Ibid., p. 81.
[12] Ibid., p. 68.
[19] Ibid., p. 83.
[21] Ibid., p. 477.

Lysenko Internet Archive
To this day no clear-cut definition of the term *species* exists in the science of biology. Yet every biologist as he observes living nature—and particularly the practical farmer, the agriculturist dealing with plants, animals or microorganisms—is struck first of all by the fact that all interconnected organic nature consists of separate, qualitatively distinct forms. For instance, in practical agriculture it is self-evident that the horse, the cow, the goat, the sheep, etc., and wheat, rye, oats, barley, carrots, etc., are separate, qualitatively distinct forms of animals and plants, respectively. The same thing is true of the wild animals and plants in free nature that environs us. Everybody can distinguish between the oak, the birch and the pine, for instance, as separate and distinct forms.

It is of such separate forms of plants, animals and also microorganisms, as has already been stated, that interconnected living nature consists. These forms of organisms, which do not interbreed under the ordinary conditions of life that are normal for them or when they interbreed do not produce normally fertile offspring, i.e., forms which are physiologically incompatible, are *species*.

In practical farming, and still more so in free nature, there are many cases where the same name is applied to forms, i.e., species of plants and animals, which, although closely related, are known to be separate and distinct and ordinarily not to interbreed. For instance, ordinary soft wheat, durum wheat, one-grained wheat, emmer wheat and others are all called wheat. Besides the dandelion proper, several other separate and distinct forms, i.e., species, which ordinarily do not cross are also called dandelion. Therefore, in order to draw lines of demarcation between the concepts of these forms, i.e., species, a binomial Latin nomenclature was long ago introduced into the systematics of botany and zoology by Linnaeus (1707-78). Thus *Triticum vulgare* is common (soft) wheat, *T. durum*—durum wheat, *T. monococcum*—one-grained wheat, etc. The first part of the designation, the noun, for instance "wheat" (*Triticum*), is the generic name common to all closely related species which in practice or science (in systematics) constitute one genus. The second part of the designation—the adjective, for instance, "common" (*vulgare*), or "durum" (*durum*)—serves to describe the precise form, the species of the plant or animal.

In practice, when only one species of plant or animal is dealt with, species are called only by their generic names, such as wheat, pine, etc., or horse, sheep, goat, etc. If several closely related species are dealt with in practice, either both names are given: common wheat (*Triticum vulgare*) or durum wheat (*T. durum*), or one of the species is called by its generic name. For instance, common (soft) wheat is designated as wheat and the other species are called by different names; thus *T. dioccum* may be called emmer.

The very structure of living nature, consisting, as it does, of groups of species similar in many respects yet at the same time separate, delimited, distinct, not interbreeding under ordinary conditions of life, suggested to naturalists ages ago that species originate from other species, that closely related species have much in common and that this which they have in common and which indicates that they are connected in origin is what characterizes them as a genus. Hence living nature itself dictated to science the binomial nomenclature of species.

Before the advent of Darwinian biology a metaphysical, antiscientific view of *species* prevailed.
Species were considered invariable and by no manner of means interconnected in origin and development. It was argued that no species could have descended from another species, that a separate act of creation had brought each species into existence independently of all the others.

Lamarck, and more particularly Darwin with his theory of evolution, utterly refuted the false assertion of the metaphysical biologists that species are eternal and fixed and that they originate independently of each other.

Darwin in his doctrine of evolution demonstrated that plant and animal forms, species, originate from each other. He thus supplied the proof that living nature has its history, its past, present and future. This is one of the immortal services performed by Darwin's theory.

But Darwinism is based on one-sided and continuous evolutionism. Darwin's theory of evolution proceeds from a recognition of quantitative changes only: it refuses to take cognizance of the compulsory, law-governed nature of transformations, of transitions from one qualitative state to another. Yet without the conversion of one qualitative state into another, without the genesis of a new qualitative state within the old, there is no development but only increase or decrease of quantity, only what is usually called growth.

Darwinism firmly established in the science of biology the idea that organic forms have their origin in other such forms. However, development in living nature was conceived of by Darwinism as only a continuous, unbroken line of evolution. In biological science—precisely science and not practice—species therefore ceased to be considered as real, separate qualitative states of living nature.

Thus, in his Origin of Species, Darwin wrote:

"From these remarks it will be seen that I look at the term species as one arbitrarily given, for the sake of convenience, to a set of individuals closely resembling each other, and that it does not essentially differ from the term variety, which is given to less distinct and more fluctuating forms. The term variety, again, in comparison with mere individual differences, is also applied arbitrarily, for convenience's sake,"

K. A. Timiryazev wrote to the same effect: "Variety and species represent merely a difference in time. No line of demarcation is conceivable here."

Thus, according to the theory of Darwinism, there should be no natural border lines, no discontinuity between species in nature.

According to evolutionism the development of the organic world may be reduced to mere quantitative changes, without anything new being born within the old, without the development of a new quality, a different totality of properties. This theory holds that so great an interval of time is required for one species to arise from another that the entire history of the human race has not been long enough for the emergence of one species from another to be observed.

After all, organic nature has been in existence for aeons of time. One would therefore suppose that this "was ample time for a new species to arise from an old and that as a result of such prolonged changes the appearance, the birth of new species should be observable by now.

But the same theory declares that actually there should be no dividing line between the new, nascent species and the old, procreating species, for which research it is supposed to be altogether impossible to observe the generation of a new species within an old one.

In spite of the theory of gradualness throughout, which recognizes no break in development, no transition from one quality to another, and which therefore asserts that there can be no boundaries between species, such boundaries do exist in actual fact, and every naturalist has long been fully aware of this. Therefore Darwinism was forced to invent so-called intraspecific competition, intraspecific struggle, to explain the gap between species. According to this theory all intermediate forms, which, it is maintained, completely filled the gaps between the species and thus constituted an unbroken gradation of forms in organic nature, dropped out in the process of the struggle as
Thus Darwin had recourse to the reactionary, pseudoscientific Malthusian doctrine of intraspecific struggle to gloss over the obvious incongruity between evolutionism and the real development of the plant and animal world. This struggle is supposedly called forth by the fact that always in nature more individuals of a given species are born than the conditions available for their existence permit. This is the basis on which Darwin built his so-called theory of divergence, i.e., divergence of characters, the appearance of breaks or discontinuities in the continuous range of organic forms, as a result of which easily distinguishable groups--species of plants and animals--are supposed to have arisen. Consequently, boundaries, breaks between closely related species, came about, according to Darwinism, not as a result of qualitative changes or the emergence of qualitatively new groups of organisms--species of plants or animals--but in consequence of a mechanical dropping out, of a mutual extermination of forms which are qualitatively indistinguishable and constitute an unbroken series.

This explains why all adherents of continuous evolutionism arrive at the conclusion that species in theory are not a result of the process of development of living nature discovered by science and practice but a convention employed for convenience in classification.

Thus a palpable contradiction has always existed and still exists between the theory of evolution and reality, i.e., the development of organic nature. Darwinism could therefore only explain somehow or other the development of the organic world. But the explanation given could not serve as an effective theoretical basis for practical transformation, could not supply the theoretical foundation for a planned alteration of living nature in the interests of practical life.

Although unable in his day to overcome Darwinism evolutionism in science, the eminent biologist K. A. Timiryazev, an ardent fighter against idealism and reaction in science, clearly perceived that species are not conventions but real phenomena of nature. He therefore wrote: "These border lines, these sundered links of the organic chain were not introduced by man into nature but forced upon him by nature. This real fact requires a real explanation."

But no such real explanation could be forthcoming from the standpoint of continuous evolutionism, and Timiryazev himself did not go beyond the erroneous Darwinian statement that this fact was the result of the supposed existence of intraspecific competition.

Only in our time and country, in the land of victorious Socialism, where dialectical materialism, developed in the works of Comrade Stalin, is the dominant world outlook, has it become possible to give a real explanation of real biological facts such as species. Kolkhoz-sovkhoz agriculture affords every opportunity for the unlimited development of materialist biological science, of Michurin's teaching--creative Darwinism. I. V. Michurin wrote: "We have as yet no correct exhaustive conception of how nature has created and still incessantly creates innumerable species of plants. At the present time it is of much greater benefit to us to realize that we have entered that stage of our historical development in which we are able personally to intervene in the actions of nature and, in the first place, can considerably accelerate and numerically increase the form building of new species, and, in the second place, artificially divert the building of their qualities in a direction more advantageous to man. We must furthermore appreciate the fact that such work, jointly performed by us and nature, represents progress of the highest order; of global significance. This will become evident to all from the results which the development of this undertaking will bring in the future--an undertaking powerfully impulsed by the Revolution that aroused millions of creative minds in the Land of Soviets. For here a considerable portion of the population has been given the opportunity to improve life round about by deliberate action."

Michurin's teaching, creative Darwinism, does not regard development as continuous evolution but as the genesis of a new quality within the old, of a quality that contradicts the old, which undergoes a gradual quantitative accumulation of its peculiar features and in the process of its struggle against the old quality constitutes itself into a new, fundamentally different totality of properties with its
own distinct law of existence.

Dialectical materialism, developed and elevated to a new high plane by the works of Comrade Stalin, is the most valuable, most potent theoretical weapon in the hands of Soviet biologists, Michurinists, and this is the weapon they must use in solving the profound problems of biology, including the problem of the descent of one species from another.

In agricultural practice as well as in nature relative but quite definite boundaries between species have always existed. By relative but quite definite specific boundaries we mean that parallel with similarity between species there always exists specific distinctness, which divides organic nature into qualitatively distinguishable yet interlocking links, or species.

No continuous, unbroken series of forms between species--different, qualitatively definite states of living matter--can be found. This is so not because the intermediate forms in a continuous range have died out as a result of mutual competition, but because there is no such continuity in nature, nor can there be. Unbroken continuity does not exist in nature; continuity and discontinuity always form a unity.

A species is a distinct, qualitatively definite state of living matter. Definite intraspecific interrelations between individuals are an essential characteristic of each species of plant, animal and microorganism. These intraspecific interrelations differ qualitatively from the interrelations between individuals of different species. Therefore, the qualitative difference between intraspecific and interspecific interrelations is one of the most important criteria for distinguishing between species and varieties.

It is wrong to state that a variety is an incipient species and a species a sharply defined variety. For if this erroneous formulation were taken as the starting point it would follow that there is no qualitative difference, no line, between species and varieties and that the species is not a reality existing in nature but something contrived for convenience of classification, for systematics. Here, and of this mention has been made above, lies one of the basic contradictions between the theory of continuous evolutionism and the realities of the organic world. Varieties intermediate between species do not exist, not because these varieties dropped out in the process of an intraspecific struggle but because they never did and do not now arise in free nature.

Varieties are forms of existence of a given species and not steps in its transformation into another species. The profusion of varieties is the result of the many-sided ecological adaptivity of the species concerned; it promotes the well-being of the species and tends to preserve it.

The more varieties within a species and the more diversified its intraspecific populations, the more certain the species and all its varieties are to thrive, through the agency of, for instance, cross-pollination.

The interrelations between individuals of the same species are, we have said, of a quality different from that of the interrelations between individuals of different species. The term species is therefore fundamentally different in biology from other botanical or zoological terms, such as genus, family, and the like.

It can easily be noticed that the interrelations between individuals of different species belonging to the same botanical or zoological genus not only do not promote the well-being of the species concerned but, on the contrary, are competitive, antagonistic. It is therefore usually difficult to find in nature or practical agriculture instances of prolonged coexistence in populations of individuals belonging to different but closely related species, i.e., of the same botanical genus. Joint existence of plant species may frequently be observed, but these species are distantly related, belong to different botanical genera. Joint existence of species of the same botanical genus is possible, however, only if the members of each species are distributed in beds or hills.

Hence the concept genus in botany and zoology does not imply ordinary ties of kinship such as intraspecific ties but indicates solely that all the species of any genus have a common origin.
The term genus serves to specify morphologically similar but qualitatively distinct species. In spite of their external similarity the individuals of the different species of a genus do not cross under the living conditions to which they are habituated or when crossed fail to produce normally fertile offspring, i.e., they are physiologically incompatible. Moreover, the interrelations between species of the same genus are competitive, mutually exclusive, as we have already stated.

Species are links in the chain of living nature, stages of qualitative distinctness, steps in the gradual historic development of the organic world.

Botanical and zoological taxonomy includes a number of so-called doubtful species. These are species of which systematists are unable to say whether the diverse plants or animals concerned form one or two species. But such species are doubtful only because these forms are little known or because biologists have found no scientifically objective criterion by which to distinguish species and therefore substitute for such criterion separate characters tentatively accepted for the various species. Proof of this is the fact that in agricultural practice people deal with a variety of animals plants and microorganisms without a doubt ever arising in the mind of any one as to whether a particular group of plants, animals or microorganisms belongs to one, two or more species. Hence doubtful species exist only in systematics but not in living nature.

Species in a state of nature are separated by specific qualitative differences, by relative but quite definite lines of distinction. These must be found so that specific forms, groups of plants, animals and microorganisms, may be properly delineated, systematized and classified.

Nor is the thesis correct which maintains that the qualitative specific features of species do not for any length of time remain constant. As a matter of fact species of plants, animals and microorganisms exist in nature as long as the conditions necessary for the subsistence of their respective individuals endure.

The prime cause of the appearance of species from other species as well as of intraspecific diversity of form is change in the conditions of life of plants and animals, change in the type of metabolism. The genesis and development of new species is bound up with such alterations in types of metabolism during the process of development of the various organisms as affect the characteristic features of the species concerned.

This is evidenced by the data obtained during the last few years as a result of research on the problem of speciation in the plant kingdom.

In 1948 V. I. Karapetian observed in his experiments that if 28-chromosome durum wheat (Triticum durum) is sown late in the autumn some of the plants are converted rather quickly, in two or three generations, into another species, into 42-chromosome soft wheat (T. vulgare).

On the basis of the genetic qualitative heterogeneity of the plant organism's body, a heterogeneity previously established by Michurinist biology, it was decided to search for grains of soft, 42-chromosome wheat in the spikes of experimentally grown durum wheat. As a result, individual grains of soft wheat were quite easily observed in the spikes of durum wheat i.e., grains of one botanical species were found in the spikes of another species.

When grains of this soft wheat (Triticum vulgare) taken from spikes of durum wheat (T durum) were sown, they produced, as a rule, soft-wheat plants. In many districts a careful search will reveal each year the presence of soft-wheat grains in some of the durum-wheat spikes arise in ordinary farm fields.

In 1949 a search for rye grains in wheat spikes was instituted in the fields of the foothill districts where winter-wheat crops are frequently found to be adulterated with rye. Until a few years ago scientists did not know the original cause of such adulteration in these districts.

V. K. Karapetian, M. M. Yakubitsiner, V. N. Gromachevsky and a number of other research workers as well as a number of agronomists and students found single grains of rye in durum- and soft-
wheat spikes, i.e., in the spikes of two wheat species which grew in the fields of various foothill districts. Over 200 such grains of rye were found in 1949. These grains were sown at the Institute of Genetics of the Academy of Sciences of the U.S.S.R., in an experimental field of the Lenin Academy of Agricultural Sciences of the U.S.S.R. at Gorki Leninskiye, and at the K. A. Timiryszev Agricultural Academy in Moscow.

Unthreshed spikes of durum and soft wheat were likewise sent to the Lenin Academy of Agricultural Sciences of the U.S.S.R. from the districts mentioned. While they were being threshed at different biological research institutions several persons found some more grains of rye.

From these grains of rye, which had developed in spikes of durum and soft wheat, a diversity of plants was grown. These plants, with few exceptions, were nevertheless typical rye. Only in a very few cases were wheat plants obtained from rye-like grains.

In all the above cases where grains of one species of plant were found in spikes of neither species neither the plants themselves nor their threshed spikes showed any signs whatever of being intermediate forms. They seemed to be typical, ordinary spikes of durum or soft wheat. But the internal state of these wheat plants was no longer the usual one, was no longer qualitatively homogeneous in respect to species. This is indicated by the fact that these wheat grains produced not only grains of wheat but also some few grains of rye, that is, grains of another species.

In 1949 the Lenin Academy of Agricultural Sciences of the U.S.S.R. received samples of oats whose panicles contained single grains of wild oats alongside of the grains of cultivated oats, that is to say, the plants of one species, *Avena sativa*, brought forth individual grains of another species, *A. fatua*. Publications abroad as well as in our country have likewise repeatedly referred to cases where wild oats were found in pure-line oats.

It has been observed year after year when cultivating branched wheat (*Triticum turgidum*) on experimental plots of the Lenin Academy of Agricultural Sciences of the U.S.S.R. and in a number of other localities that admixtures of soft and durum wheat, oats, 2- and 4-rowed barley and also spring rye appear in the crops.

All our observations led us to conclude that the original source of these admixtures was the branched wheat (*Triticum turgidum*) itself.

In 1950 it was discovered in several cases that barley plants which were growing as an admixture in branched-wheat crops had developed from grains which in external appearance could not be distinguished from branched-wheat grains.

In practical farming it has long been assumed and repeatedly asserted that one kind of agricultural plant can be converted or transformed into another, as for instance wheat into rye. A great controversy was waged in print on this subject in our country as early as the first half of the previous century. Therefore the conversion of durum wheat into soft or the conversion of durum and soft wheat into rye would seem by itself to be nothing new. However, all the new facts we have adduced were obtained in a systematic way or as the result of a systematic search.

As regards the past, before our investigation started, the facts were as follows. In fields sown to durum wheat individual plants of soft wheat were discovered. When this wheat was resown the soft-wheat plants multiplied more and more and finally ousted the durum wheat. Similarly, individual rye plants were found amidst winter wheat. When the seeds obtained from crops grown in such fields were resown the rapidly multiplying rye plants pushed out the wheat. But scientists refused as a matter of principle to consider any such discoveries of plants of one species in the stands of other species as a result of the conversion of one species into another. Legitimate doubts were always voiced. It was not established whether or not the prime cause of this adulteration was ordinary mechanical admixture so frequently met with. There was no assurance that the original seeds really did not contain an admixture of a few seeds of another species, or that seeds of another species had not been carried to the sown field in question by water, wind, birds or some other agency; nor could
one be sure that seeds of the admixed breed had not been in the soil of that field for a long period of
time, etc.

This explains why it was impossible to prove by facts relating to the past that the emergence of one
crop species from another species might also be an original source of the various crop admixtures
and adulterations, besides their frequent introduction into crops by mechanical means.

All the enumerated objections to the idea of one species giving rise to another become invalid in the
cases referred to by us. Individual grains of rye discovered in spikes of wheat which had grown for
several generations under definite conditions could not possibly have been introduced into these
spikes from without by either birds or man or in any other way.

These grains of rye were generated by wheat plants and developed in spikes of wheat.

The supposition that these seeds might be of hybrid origin also goes by the board. It is a known fact
that wheat can be crossed with rye, though seldom. However, in these cases the product obtained is
an obvious rye-wheat hybrid which can readily be distinguished from wheat and rye by its external
appearance.

Besides, rye-wheat hybrids, as a rule, are self-sterile; they yield no seeds unless they are pollinated
with the pollen of one of their parents, preferably the wheat. In the case at hand the grains of rye
from the wheat spikes produced ordinary rye plants with normal fertility. The said plants manifested
no hybrid properties whatever.

The same applies to the other facts we have mentioned.

The above examples of the generation of particular plant species by others are particularly valuable
because analogous cases may be observed any year in suitable fields. Similar results may likewise
be obtained by cultivating plants specially sown under experimental conditions for this purpose.

The factual material so far obtained on the problem of species formation concerns the plant world
only. We do not yet have the data essential to demonstrate how species are formed in the animal
world. But we may rest assured that before long the development of the theory of Michurinist
biology will make it possible to accumulate data also for zoological objects analogous to the data
taken from the world of plants.

The material available on the problem of speciation in the plant world affords grounds for belief
that many, if not all, existing species of plants can arise de novo at the present time, and under
suitable conditions repeatedly do arise from other species. Moreover, one plant species may give
rise to several species closely related to it. For example, a single species, durum wheat (Triticum
durum) can produce both soft wheat (T. vulgare) and rye (Secae cereale).

A change in the environmental conditions essential to the specific nature of the particular organisms
sooner or later changes this specificity perforce--certain species originate other species. Under the
influence of the changed conditions, which have become deleterious to the natures (heredities) of
the organisms of the plant species growing here, rudiments of bodies of other species more fit for
the changed environmental conditions arise and take shape in the bodies of the organisms
constituting these species. Such qualitative heterogeneity in the body of a plant organism which is
characteristic of various other species may in some cases be detected even by the naked eye.

The appearance under the influence of suitable environmental conditions of specific qualitative
heterogeneity in the bodies of plants explains the often repeated creation of some species by others
that have long been in existence. When plants of a particular species somehow or other come under
the influence of conditions relatively unfavourable for the normal development of the peculiar
features of their species, enforced alteration takes place, and rudiments of another species with
peculiar features, more in accordance with the new environmental conditions, appear in the plant
organisms of that particular species. As they are more responsive to the particular conditions, the
isolated specimens of the other species generated within the old species rapidly multiply and are
capable under these conditions of extruding the species which gave them birth. If this goes on in
free nature the emergent species will rapidly multiply and completely oust from the habitat the species that gave rise to it.

Things are otherwise in practical agriculture where the plants cultivated are shielded and protected from weed species by agrotechnical methods.

Scientists have long known that many weed species grow only in cultivated fields and that in free nature they not only do not but cannot exist. Thus, if a field overgrown with numerous species of weeds is abandoned, remains uncultivated and unsown, it will soon enough, in about 20 or 30 years, be completely rid of its many weed varieties. Such a field will no longer grow species of weeds but other plants species which are the peculiar product of ordinary unbroken, untiled plots in the particular locality.

Weed species are generated partly by species existing in free nature and partly by cultured plant species. For instance, cultivated oats may give rise to wild oats, one of the worst of weeds.

Not a single plant species at home on virgin soil will, when that soil is broken, find the conditions requisite for its normal development. Therefore the species that grew on the virgin soil change sooner or later with greater or less rapidity but with absolute certainty into other species suited to the conditions created by the tilling of the soil. The same takes place with cultivated plants when they encounter unfavourable climatic or agrotechnical conditions. They are also certain to change sooner or later into other species better adapted to these conditions.

Some weed species have long been introduced into cultivation. Rye, for instance, begotten under certain conditions by wheat, is under these conditions a pernicious weed which drives the wheat from the field. In such districts special measures are therefore taken--crop weeding, sorting wheat seeds from rye seeds--to protect wheat at all times from extrusion by rye. In other districts, on the contrary, rye has long been a cultivated plant. The same can be said of soft wheat. It is frequently produced by durum wheat and in that event adulterates it. Durum wheat is therefore protected against such adulteration by weeding the seed crops. Soft wheat, on the other hand, is a crop that man has cultivated for ages.

Many another species of cultivated plants are the products of other cultivated plant species. This will explain why no wild, ancestral forms have been found so far for many species of cultivated plants.

Bad agrotechnique, which does not create in the fields the good conditions that cultivated plants require, leads to a deterioration of the nature of these plants with respect to yield and quality of crop. Simultaneously, bad agrotechnique promotes the multiplication of various species of weeds, the seeds and other rudiments of which are to be found in the soil or are introduced into it by badly sorted sowing material. Finally, bad agrotechnique may also create the conditions for the generation de novo, by cultivated plants, of isolated rudiments of a number of weeds.

To ascertain the original sources of the emergence of particular species of weeds and discover the environmental conditions which determine such emergence constitutes a task of paramount importance to agronomic biology. Research work conducted to this end will not only facilitate the control of weeds now existing in the fields but also enable us to preclude the possibility of weed species being brought into existence by other such species or by cultivated plants.

The creation of new conditions for organisms or the withdrawal of these organisms from the action of certain existing environmental conditions makes it possible to produce new plant species useful to practical agriculturists and also to preclude the possibility of generating weed species harmful to agricultural practice.

This is one, but not the only one by far, of the practically important tasks involved in the theoretical elaboration of the problem of speciation.
Preface to I. V. Michurin: Selected Works

The name of the famous Russian scientist in the field of biology, Ivan Vladimirovich Michurin, is known all over the world. He is known as a daring innovator in science, as an indefatigable researcher and as a great transformer of nature. He is particularly known and appreciated in the Land of the Soviets, the land of victorious Socialism, where there is every opportunity for the glorious growth of science, and where the creative and mighty talent of the great Russian scientist unfolded itself in all its power.

I. V. Michurin laid the foundation for a new materialistic biological science, the science dealing with the development and control of living nature. The general theory of the development of living nature and its directed alteration is the basis, the core of materialistic biology. Michurin's teaching contains within itself all of the basic elements of such a science: the principles and methods of research and the dialectical-materialistic views on the process of evolution in the plant and animal world. That is why Michurin's teaching is not of limited significance, but of general biological importance, and equally concerns all branches of biological science--horticulture, animal husbandry, medicine, physiology, ecology, and so on.

I. V. Michurin's theoretical principles are irrefutable, for they are correct inasmuch as they are founded not on mere reasoning or abstract deductions (as is the case with formal geneticists), but on numerous facts observed in life, in practice. The principles were established as a result of painstaking labour over many years, of a persistent struggle to master the laws of living nature. Step by step, with the conscientiousness of a genuine scientist and the perspicacity of a naturalist of genius Michurin penetrated the profound secrets of nature and disclosed them skilfully.

In his scientific-research work Michurin always kept in mind Engels' view that in dialectics "...nothing is final, absolute, sacred. It reveals the transitory character of everything and in, everything; nothing can endure before it except the uninterrupted process of becoming and of passing away, of endless ascendancy from the lower to the higher." In citing this most important precept of Engels, I. V. Michurin states:

"This principle has always been and remains the basic principle of all my work. It has been emphasized in all of my numerous experiments on the improvement of existing of fruit and berry plants."

Incidentally, many scientists who have no positive accomplishments to their credit either in theory or in practice "...have declared that plant organisms existing on the face of the earth do not change, that one cannot improve on nature, but I declare that all the diversity of plant forms has originated from a very limited number of plants as a result of an endless process of change taking place in nature, and I advance numerous facts to prove that man can and should improve on nature...." (I. V. Michurin.)

Michurin's teaching proceeds from the basic principle that new properties of plants and animals acquired under the influence of external conditions of life can be transmitted hereditarily. This means that qualitative change in the nature of plant and animal organisms depends on the conditions of life.
The main point in Michurin's teaching, therefore, is not crossing or hybridization, as is deliberately asserted incorrectly and falsely by the representatives of bourgeois formal genetics. The main point, the basic principle in Michurin's teaching is the role played by environment, the purposeful and directed training of hybrids.

Michurin regarded hybridization merely as the source of variability of properly selected parental forms necessary for obtaining new and desired properties in hybrids.

Michurin pointed out time and again that the work of a breeder does not end but only begins when hybrid seeds are obtained. The young organism resulting from the cross of the initial parental pairs is distinguished by its destabilized heredity and hence possesses great plasticity. By applying Michurin's diverse methods of training, it is possible to alter such an organism in the direction desired by the breeder.

Michurin pointed out that if an improper method of training is used, we may obtain a complete wilding from the best hybrid of cultivated varieties, and, contrariwise, by applying the required methods of training we may obtain a good new variety from a hybrid seedling possessing undesirable qualities. After all, it appears," Michurin stressed, "that the hybrid's constitution depends only one-tenth on the parents and nine-tenths on the influence of the environment."

Darwin discovered the law of development of the organic world and established a proper conception of the evolution of living organisms. But he could not indicate how to control evolution so as to create new, forms of plants according to plan for the benefit of man. This task devolved upon Michurin.

By developing the positive aspects of Darwin's teaching Michurin raised materialistic biology to a new, higher stage and thereby laid the foundation of Soviet creative Darwinism.

Already at the early stages of his work, Michurin completely refuted by numerous experiments the false theory of the well-known horticulturist Grell according to which old plants of southern varieties that had borne fruit many times could be acclimatized in more northerly regions.

Michurin proved by experiments that the acclimatization of plants is indeed possible, but "...only by planting the seeds. No foreign variety, if not already able in its native environment to endure temperatures as low as the minimum temperature of its new home, can be acclimatized by transplanting complete specimens, cuttings, layers, and so on."

Michurin here for the first time propounded the theoretical principle that the nature of a variety begins to be formed from the very first days of the seed's development, and that during this period it can be most easily changed in the desired direction by the conditions of training.

Michurin's long and persistent efforts to find improved methods for extending the northernmost bounds of fruit cultures led him to apply hybridization of geographically distant forms of plants with subsequent directed training of the hybrid seedlings. And the farther away from their native place were the plants he took for hybridization, the more fully were combined in the hybrids the positive qualities of their parents, and the more readily did such hybrids adapt themselves to the severe conditions of the central zone of Russia, where I. V. Michurin lived and worked.

Michurin created the majority of his standard varieties precisely by the hybridization of geographically distant races and species of plants. Almost every variety bred by him serves as vivid proof of the correctness of his teaching that living beings, particularly young hybrid organisms, vary greatly under the influence of external conditions.

One of the greatest discoveries made by I. V. Michurin is the completely proved proposition that the variability of organisms arising both by sexual and asexual, vegetative means is governed by the same laws, and that there is no difference in principle between sex and somatic cells. Michurin proved this principle of major importance by his numerous experiments and researches on the vegetative hybridization of plants.
The sex cells, Michurin pointed out, in the final analysis are formed at a definite stage of the development of the organism from the very same somatic cells which go to build up its entire body. Hence, there is the closest interaction between vegetative and sex cells.

By means of vegetative hybridization, Michurin created fruit varieties of excellent quality. Along with his other varieties, bred by means of sexual hybridization, they are now propagated as standard plants in the majority or districts and regions of the Soviet Union.

*Vegetative hybrids provide indisputable material for the proper understanding of that highly important property of organisms—their heredity.* By controlling environmental conditions it is possible to change varieties in the desired direction, to perfect and to create new varieties possessing the heredity which we need.

I. V. Michurin elaborated the doctrine of development on the basis of the interrelations between the organism's historical past and its heredity. He considered the organism in indissoluble connection with environment, in unity with it. Michurin considered as decision the role of the external conditions in the formation of the organism. "It appears," Michurin wrote, "that some people who imagine themselves to be experts in the laws operating in the plant world, naively question my assertion about the influence of environment on the process of formation of new forms and species, alleging that it has not been yet scientifically proved.

"...First of all it is interesting to know whether they really believe that all of the 300,000 different kinds of plant species originated solely by means of hereditary transmission of parental characters (without any influence whatever on the part of environment).... Why, such a conclusion would be an utter absurdity. Indeed, it cannot be supposed that the entire vegetable kingdom existing on the globe at the present time originated from the first individual living plant organisms by means of cross fertilization in the course of tens of millions of years, without the influence of the environment the conditions of which so often and so greatly changed in the course of the centuries and millenniums that have passed."

By not limiting itself to deepening and developing Darwinism Michurin's teaching has played and continues to play an enormous role in exposing the antiscientific character of the various reactionary idealistic theories of the opponents of materialistic biology.

For many years the idealistic reactionary trend of Weismannism (Mendelism-Morganism) held sway in biological science.

The struggle against this antiscientific trend was waged by the only correct one--the materialistic trend of Michurin.

A sharply intensified struggle which divided the biologists into two irreconcilable camps, took place around the old and fundamental issue: *can plant and animal organisms inherit characters and properties which they acquire during their life? In other words, does the qualitative alteration of the nature of a plant or animal organism depend on the various conditions of life, i. e., on environment that influences it?*

The Michurin materialistic-dialectical trend in biology cites numerous facts in affirmation of such dependence. The Weismann (Mendel-Morgan) idealistic-metaphysical trend baldly denies such dependence, without adducing any proof thereof.

In August 1948 a session of the Lenin Academy of Agricultural Sciences of the U.S.S.R. devoted to a discussion of the situation in biological science was held in Moscow. At this session the Weismann (Mendel-Morgan) trend in biology was completely exposed and ideologically routed, as an antiscientific, reactionary, idealistic-metaphysical trend, divorced from life and sterile in practice, in contrast to the Michurin trend, which represents the creative development of Darwin's teaching, and is a new and higher stage in the development of materialistic biology. "The keynote of this discussion was Michurin's famous motto: 'We cannot wait for favours from Nature; we must wrest them from her.' This injunction of Michurin's, it may be said, is infused with the Bolshevik
spirit, and is a call not only to scientific workers but also to the millions of practical farmers to engage in active creative work for the benefit and glory of our people." (V. M. Molotov.)

Michurin's teaching--the only progressive biological science in the world --has developed and become strong in the U.S.S.R., the land of victorious Socialism. That is no accident. "The Michurin teaching," Academician T. D. Lysenko has said, "is inseparable from the practical collective-farm and state-farm activity. It is the best form of unity of theory and practice in agricultural science."

Michurin himself wrote that without the Soviet system he would have been "an unknown hermit of experimental horticulture in tsarist Russia."

Recalling pre-revolutionary times, Michurin wrote: "Before the Revolution my whole path was strewn with derision, neglect and oblivion.

"Before the Revolution I used to be insulted again and again by the judgments of ignoramuses, who declared all my work to be useless, to be mere 'fancies' and 'nonsense.' The officials from the Department of Agriculture shouted at me: 'You dare not do it!' The official scientists declared my hybrids to be 'illegitimate.' The clergy threatened me: 'Don't commit blasphemy! Don't turn God's garden into a brothel!' (that is how hybridization was characterized)."

I. V. Michurin, however, persistently strove to realize his aims. Being an ardent patriot of his country and an enthusiastic innovator, he devoted himself utterly to the service of his people. "I worked hard to fulfil the aim I had set," Michurin wrote later, "though I was without means, had no established standing, was completely isolated from society, and was engaged in a constant struggle against poverty and stagnation, making the best of the meagre resources which, along with painstaking and at that time absolutely unpaid scientific work, I was able to earn by my personal labour as a railway clerk and precision mechanic."

Knowing of Michurin's outstanding work and of his financial difficulties, the Department of Agriculture of the United States in the years 1911-13 repeatedly proposed that he emigrate to America, or that he at least sell the entire collection of his varieties, initial forms, and hybrids, on very favourable terms, of course. Michurin, however, each time declined the proposals. He considered that his accomplishments and collections should not serve to enrich capitalists, but should become the property of the people.

The first to direct attention to Michurin's work was V. I. Lenin. Despite the fact that the Civil War was raging and that the country's economy was in ruins, the Soviet Government in the very first months of its existence rendered Michurin the necessary aid. His nurseries at Kozlov (now called Michurinsk) were twice visited by the chairman of the Central Executive Committee, M. T. Kalinin.

Subsequently, in 1928 well-equipped laboratories were established in the Michurin nursery. This nursery was reorganized into a selection and genetics station, and later, in 1931, into the Michurin Central Genetics Laboratory.

For his outstanding services in creating new plant forms, the Soviet Government conferred on I. V. Michurin the Order of Lenin and the Order of the Red Banner of Labour. In 1932, the city of Kozlov, in which Michurin had lived and worked, was by a decision of the Presidium of the Central Executive Committee of the U.S.S.R. renamed Michurinsk.

Since that time the city of Michurinsk has become the largest scientific research centre for the transformation of living nature, the largest centre for disseminating Michurin's general biological ideas and the building up of progressive, Soviet agrobiological science. Bitterly recalling the gloomy period of his hard life and work under tsarism, I. V Michurin remarked that "...Only under the Soviet system did I gain recognition in my own country. The first to take notice of my work was Vladimir Ilyich Lenin."

"Now that I am surrounded by the care and attention of the Party, led by Comrade Stalin, I have the opportunity to work even more productively in the great cause of renovating the earth."
On the eve of the 60th anniversary of his scientific activity I. V. Michurin sent a letter to Comrade Stalin, in which he summarized, as it were, the aid rendered him by the Party and the Government. "The Soviet system," Michurin wrote in that letter, "has transformed the small undertaking which I started on a mean garden plot sixty years ago for breeding new fruit varieties and creating new plant organisms into a vast Union-wide centre of industrial fruit breeding and scientific plant breeding, with thousands of hectares of orchards, magnificent laboratories and facilities and dozens of highly skilled researchers.

"And myself, a lone experimenter unrecognized and ridiculed by the official savants and bureaucrats of the tsarist Department of Agriculture, the Soviet system and the Party which you lead have made the director and organizer of experiments with hundreds of thousands of plants.

"The Communist Party and the working class have given me everything I need--everything an experimenter can desire for his work."

I. V. Michurin was particularly deeply affected by the warm telegram of greetings received from Stalin on the 60th anniversary of his scientific activity. The telegram reads as follows:

"Most sincerely congratulate you, Ivan Vladimirovich, on the occasion of your sixtieth anniversary of productive labour for the good of our great motherland.

"Wish you health and new achievements in work of transforming fruit growing.

"I press your hand warmly.

J. STALIN."

Michurin's teaching has yielded excellent results.

Firstly, Michurin himself originated about 300 new varieties of fruit and berry plants. But that is not all. He pushed the notorious Humboldt zone far to the north. He made plants grow and bear fruit in regions where, not long before his day, man had never dreamed of seeing trees bending under the weight of juicy fruits. Grapes in Chelyabinsk, apricots in Siberia, pears in the Altai Mountains. Like the magician in the fairy tale Michurin scattered over the vast expanses of the Soviet Union green massifs of fruit orchards and decorated them with hitherto unseen varieties.

But this, too, is not all.

The huge million-strong army of his followers, the Michurinites, is the most precious capital created by the great transformer of nature. It is they who are mastering the great heritage bequeathed to them by Michurin. It is they who are decorated with that brightly shining mark of honour--the star of Hero of Socialist Labour, of labour glorified and honoured on the socialist fields of the Soviet State.

The resolution of the session of the Lenin Academy of Agricultural Sciences of the U.S.S.R., which was held in August 1948, placed on record the great fruitful work of its president, Academician T. D. Lysenko, who headed the struggle to expose and to rout ideologically Mendelism-Morganism, and who took over the banner of Michurin materialistic biology. Academician Lysenko is successfully and fruitfully advancing Michurin's teaching. He is working on the most profound theoretical problems of modern biology. At the same time he is furnishing brilliant examples of the solution of practical tasks that arise in agriculture. Thus, having elaborated the theory of the phasal development of plants, T. D. Lysenko has, on the basis of this theory, worked out a valuable agrotechnical method known as vernalization which is now being applied in practice on millions of hectares of land. Among other agrotechnical methods which are the results of Lysenko's creative work are the sowing in stubble of winter crops in Siberia, summer planting of potatoes in the southern areas, cluster planting of kok-saghyz and forest belts, wide row sowing of millet, topping of cotton plants, and so on.

"...The future belongs to Michurin," Academician Lysenko stated in concluding his report at the
session of the Lenin Academy of Agricultural Sciences of the U.S.S.R., "V. I. Lenin and J. V. Stalin discovered I. V. Michurin and made his teaching the possession of the Soviet people. By their great paternal attention to his work they saved for biology the remarkable Michurin teaching. The Party, the Government, and J. V. Stalin personally, have taken an unflagging interest in the further development of the Michurin teaching. There is no more honourable task for us Soviet biologists than creatively to develop Michurin's teaching and to follow in all our activities Michurin's style in the investigation of the nature of the development of living beings."

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The Lysenko controversy has been honored in *The Times* by a special article. To anyone who knows the ropes the rumpus is laughable. Lysenko is a neo-Lamarckian who believes that acquired characteristics are inherited, in flat contradiction to the neo Darwinist Weismann, who denied that any acquired characteristic can be inherited, and was so fanatically Determinist that he maintained that every act of a living creature was imposed on it by external circumstances, and could not be prevented or initiated or forwarded by any legislature or any purpose or desire or volition of its living agents. As Butler had put it to Darwin, Determinism 'banishes mind from the universe.' Call it Fatalism and it becomes plain at once that it is a doctrine that no State can tolerate, least of all a Socialist State, in which every citizen shall aim at altering circumstances for the better purposely and conscientiously, and no criminal nor militant reactionary can be excused on the ground that his actions are not his own but the operation of external natural forces predetermined from the beginning of the world and entirely beyond his control or prevention. There is not a civilized country on earth which does not hold its citizens responsible for their conduct, persecuting ruthlessly all who act too irresponsibly, and in extreme cases certifying them as madmen and locking them up.

Lysenko is no Determinist. Following up Michurin's agricultural experiments he found that it is possible to extend the area of soil cultivation by breeding strains of wheat that flourish in a sub-Arctic climate, and transmit this acquired characteristic to its seed. This hard fact nullified Weismann and his Determinism, as facts are continually nullifying paper theories and hypotheses.

Lysenko is not the first in the field. Samuel Butler realised 80 years ago the enormity of the Fatalism inherent in Darwinism, though Darwin, a Unitarian, was not a Darwinist, but a naturalist whose specialty was the semblance of evolution produced by what he called Natural Selection. Butler, in two books entitled *Life and Habit* and *Luck or Cunning?* fought Darwin tooth and nail.

Butler was followed in 1906 by myself. After a careful observation of my own acquired habits I pointed out, in the course of a lecture on Darwin to the Fabian Society, that evolution means that all habits are inherited. I cited the fact that as breathing is an inborn habit, and speaking, like skating and bicycling, one which every generation has to acquire, proves that habits are acquired by imperceptible increments at each generation, the inborn habits being those already fully acquired, and the rest only in process of acquirement.

I was followed by Bergson, who supplemented Butler's views and mine with a philosophy of our Creative Evolution.

After Bergson, Weismannism lost its stranglehold on the scientific world. Scott Haldane (father of J.B.S.), Needham, and in Russia Michurin and Lysenko, broke away from Fatalism, not polemically, but by simply ignoring it.

And now comes the joke. Fatalism is now dropped or certified as Materialism gone mad. Creative Evolution is basically Vitalist, and, as such, mystical, intuitive, irrational, poetic, passionate,
religious, and catholic; for neither Lamarck nor Butler nor I nor Bergson nor Lysenko nor anyone else can account rationally for the Life Force, the Evolutionary Appetite, the *Elan Vital*, the Divine Providence (alias Will of God), or the martyrdoms that are the seed of Communism. It has just to be accepted as a so far inexplicable natural fact.

Weismannism, dismissing this force as an illusion produced by Darwinian Natural Selection, is soulless, totally rationalist, fatalist, anarchist, mechanist, and arch-materialist. It immobilises its votaries morally, driving Lysenko to the extremity of demanding its persecution as a Voodoo.

Lysenko is on the right side as a Vitalist; but the situation is confused by the purely verbal snag that Marx called his philosophy Dialectical Materialism. Now in Russia Marx is a Pontif; and all scientists who do not call themselves Materialists must be persecuted. Accordingly, Lysenko has to pretend that he is a Materialist when he is in fact a Vitalist; and thus muddles us ludicrously. Marxism seems to have gone as mad as Weismannism; and it is no longer surprising that Marx had to insist that he was not a Marxist.

The fault is wholly that of the detestable Hegelian jargon which hampered and bothered the Socialist movement in the eighteen sixties, and is mere abracadabra in England. We have a parallel mix-up at home. In the Church of England no candidate for ordination can be inducted to a living unless when catechized by the Bishop he tells the flat lie, which the Bishop knows to be a lie, that he believes without mental reservations everything in The Bible literally. His justification is that as he will not be allowed to exercise his vocation without going through this imposture, he does it under duress and is therefore not morally responsible for it. Lysenko has to tell the flat lie that he is a Materialist, and can make the same excuse for what it is worth. Meanwhile it is our business not to let this bogus controversy be used as a red herring to split us into two factions squabbling about nothing. The trick is an old one: Divide and Govern.

Anyone can be a good Christian without believing that Joshua stopped the sun, or Jesus raised Lazarus from the dead. So also is it possible to be a Socialist without, like Engels, making *Das Kapital* 'the Bible of the working class,' or accepting Marx's version of the exploded capitalist theory of value or his attempt to account for Surplus Value by an analysis of the circulation of commodities that is now tiresome nonsense. He knew nothing of the theory of rent and interest; and his English translators, like those of Wagner, made a mess of the German philosophic lingo, not having the literary genius of Carlyle, who assimilated it superbly. If only they had read the Jacobean Bible and learnt from it how to write English as Bunyan did, Marx would not have had to wait twenty-five years for his doctrine to be put into plain English by Hyndman, Morris and the Fabians. By that time he was dead.

G.B.S.

P.S. Sir Henry Dale's resignation of his membership of the Soviet Academy of Science on the Lysenko issue is entirely conscientious and honorable in intention. But the real issue is between the claim of the scientific professions to be exempted from all legal restraint in the pursuit of knowledge, and the duty of the State to control it in the general interest as it controls all other pursuits. To my old question 'May you boil your mother to ascertain at what temperature a mature woman will die?' the police have a decisive counter in the gallows. To Lysenko's question 'Can the State tolerate a doctrine that makes every citizen the irresponsible agent of inevitable Natural Selection?' the reply is a short No. The Yes implied by Sir Henry Dale's resignation is a hangover from the faith of Adam Smith, who believed that God interferes continually in human affairs, overruling them to a divine purpose no matter how selfishly they are conducted by their human agents. Experience has not borne this faith out. Laissez-faire is dead. Sir Henry should think this out.

My long political experience has taught me that what we are hardest up against is not general ignorance of Communism and all the rival paper Isms, but of the status quo, our notions of which are so fantastically Utopian that we daily reproach Russians and foreigners in general for practices
and institutions and codes that are in full blast here, and in fact mostly originated in Merry England. (World Copyright).
'The Problem of Lysenkoism' by Richard Lewontin and Richard Levins (In: Hilary and Steven Rose (eds.), The Radicalisation of Science, Macmillan pb, 1976, pp. 32-64) is the first study of this issue (which I have seen) published in English which is illuminating for Marxists. That is, it is the first analysis to break through the crude use/abuse model which has characterised the writings on the subject in both East and West. It looks deeper than the liberal-to-reactionary scientific self-consciousness which sees the history of Lysenkoism as a cautionary tale about the intrusion of the alien values of politics and ideology into the domain of value-neutral science. Hitherto everything I have read on the subject has taken this self-congratulatory line, e.g., Zirkle's American Cold War Death of a Science in Russia, Medvedev's brave Soviet liberal Rise and Fall of T. D. Lysenko, and Joravsky's American functionalist The Lysenko Affair (though thoroughly researched and immensely informative). Although Lewontin & Levins don't mention it, I would add Graham's Science and Philosophy in the Soviet Union., which has a chapter on genetics which was written before Joravsky's book appeared and draws parallel conclusions. This orthodoxy has lately been joined by Louis Althusser who uses the Lysenko affair as a stick with which to beat the abuses of Stalin in the Soviet union and in the French Communist Party (PCF), which supported both Lysenko (1948-52) and the Zhdanovist movement for 'proletarian science'. These authors emerge from their studies with a common lesson: avoid the fatal admixture of science and ideology.

Lewontin & Levins have introduced a discordant note into this scientistic chorus and have begun the serious analysis of Lysenkoism from the point of view of political economy, ideology and the problems of building socialism. (I tried in 1971 to undercut the prevailing liberal consensus in an essay on Joravsky's book for the New York Review of Books. Having commissioned it, the editor rejected it, among other reasons, for not placing primary emphasis on the abuses of power under Stalin as an explanation of Lysenkoism, i.e., for not accepting the liberal account.)

They begin by setting aside the available points of view, including those who reduce Lysenkoism to the personal power and patronage of Stalin as well as the view of ultra-Maoists who see Lysenkoism as a triumph of dialectical materialism over the international scientific orthodoxy. They provide an admirably wide framework for the analysis: 'Lysenkoism, like all non-trivial historical phenomena, results from a conjunction of ideological, material and political circumstances, and at the same time is the cause of important changes in those circumstances... Of course it is true that authoritarian political structures in the Soviet Union and bureaucratisation of the Communist Party had a powerful effect on the history of the Lysenkoist movement. Of course it is the case that the methods and conclusions of science contain deep ideological commitments that need to be re-examined. But there are other factors as well that were part of the material and social conditions of the Soviet Union and which were integral in the Lysenkoist movement' (pp. 32-3). They begin, that is, by declaring an intention to give due weight to traditional power-political factors and to integrate these with ideological aspects of science. But they seek to go further and to root the science in social, political and economic history. It is the bringing together into one argument of these aspects of the historical phenomenon of Lysenkoism which makes their analysis so refreshing and their perspective so promising. In what follows I want to summarise their
argument and to suggest ways of extending it in the directions they have indicated. (See below–
Appendix – for a summary of the life and work of T. D. Lysenko, couched in the rhetoric of western
red-baiting.)

Their own interest in the issue has three aspects, each of which is potentially served by a study of
Lysenkoism:

(1) the attractions of a case study towards a materialist history science – an approach which is still
in its infancy in spite of the pioneering work of Hessen and Bernal (there is more happening in this
sphere than they seem to know about or their editors acknowledge);

(2) the problem of the relationship between scientific methodology and the requirements of a
science aimed at urgent practical social needs (this issue has world-wide ramifications, e.g., in
China, Tanzania, Mozambique, Vietnam, Cuba);

(3) 'As working scientists in the field of evolutionary genetics and ecology, we have been
attempting with some success to guide our own research by a conscious application of Marxist
philosophy. We therefore cannot accept the view that philosophy must (or can) be excluded from
science, and deplore the anti-ideological technocratic ideology of Soviet liberals. At the same time,
we cannot dismiss the obviously pernicious use of philosophy by Lysenko and his supporters
simply as an aberration, a misapplication, or a distortion dating from the era that is often brushed
aside as 'the cult of personality' (with or without naming the personage in question). Nor is it
sufficient to note that Marxism has had its signal successes despite Lysenko, with its pioneering
work in the origin of life among its achievements. Unless Marxism examines its failures, they will
be repeated' (p. 34). That kind of candour and commitment to integration of theory and practice is
refreshing.

They go on to provide a very illuminating overview of Lysenkoism under the following headings:
its philosophical and scientific claims, the conditions creating it, and its apogee and decline. The
concluding sections consider two issues: The first is, 'Did Lysenkoism affect Soviet agriculture?'
They provide statistics on wheat yields which show that Lysenkoism does not seem to have affected
that crucial crop adversely. On the other hand, one of the most absurd of Lysenko's procedures,
'cluster planting', is estimated to have wasted one billion roubles. Also when Khrushchev was
dismissed in 1964, one of the major charges against him was the stagnation of agriculture since
1958, in particular the disastrous results of his Virgin Lands proposal of 1954, which was supported
by a scientific memorandum by Academician T. D. Lysenko, who remained its chief scientific
adviser.3

These were some of the ramifications in politics. Looking to science itself Lewontin and Levins do
not detail the devastation of the content and personnel of biology, medicine and science in general.
When I was in the Soviet Union in 1971, I met a number of refugees from biology who had found a
haven in the history of science. They described the worst effects of shambolic curricula and of
censorship in scientific publishing. There were no genetics textbooks published between 1938 and
the early 1960s, and no genetics at all was taught to generations of medical students. Imagine trying
to practice modern medicine with that gap in one's knowledge. One form of 'stupidity' in the period
was the inability to memorize and regurgitate Lysenkoist nonsense. I remember one vivid account
of a biologist who failed his exams on this topic. On the other hand, there were holes in the net. The
original Watson-Crick article on DNA did get published in an obscure work on nucleotide chemistry
- which immediately sold out.

Returning to the second of their concluding questions, they ask, 'Can there be a Marxist science?'
and reply: 'Lysenkoism is held up by bourgeois commentators as the supreme demonstration that
conscious ideology cannot inform scientific practice and that "ideology has no place in science". On
the other hand, some writers are even now maintaining a Lysenkoist position because they believe
that the principles of dialectical materialism contradict the claims of genetics. Both of these claims
stem from a vulgarisation of Marxist philosophy through deliberate hostility in the one case or
ignorance in the other. There is nothing in Marx, Lenin or Mao that is, or can be, in contradiction with the particular physical facts and processes of a particular set of phenomena in the objective world.

'The error of the Lysenkoist claim arises from attempting to apply a dialectical analysis of physical problems from the wrong end. Dialectical materialism is not, and never has been, a programmatic method for the solution of particular physical problems. Rather, dialectical analysis provides us with an overview and a set of warning signs against particular forms of dogmatism and narrowness of thought. It tells us: "remember, that history may leave an important trace"; "Remember that being and becoming are dual aspects of nature" "Remember that conditions change and that the conditions necessary to the initiation of some processes may be destroyed by the process itself"; Remember to pay attention to real objects in space and time and not lose them utterly in idealised abstractions"; "Remember that qualitative effects of context and interaction may be lost when phenomena are isolated", and above all else, "Remember that all the other caveats are only reminders and warning signs whose application to different circumstances of the real world is contingent" (pp. 59-60).

Although helpful and charmingly put, I think this position is too modest. Of course dialectical materialism (diamat) is not the key to empirical discoveries any more than were Descartes' 'clear and distinct ideas; a basis for deductions to empirical findings. On the other hand, dialectical analysis does provide more than an overview and a set of cautionary reminders. It is a philosophy of nature, persons and society with labour at the heart of its ontology, while the conception of dialectical processes (interpenetrations and mutual constitutiveness rather than simple causalities and mechanical interactions) is an alternative world view to that of the positivism of the integrated conceptions of capitalism and its science and technology. It is in this sense that Lewontin and Levins' analysis is only a beginning, albeit a very useful one.

We have to go on and enter fully into the ongoing debates about Marxism, science and ideology, scientificty, historical materialism, and the relations among science, technology and the mode of production. If we are to be serious and fully Marxist about science, we have to work out a view and practices which treat science in terms of the contradictions between the forces of production and the relations of production. This work has hardly begun, though there are those (traditional, vulgar Marxists) who think that the answers are known and need only to be applied. Lewontin and Levins are not of that persuasion, but their list of nostrums reveals that they, like most of the rest of us in the radical science movement, have no very clear idea about how to develop an historical materialist theory and practice in science.

They have a section on 'The Ideological and Social Implications of Genetics', which begins, 'It is essential to distinguish between what we might call the "minimal theoretical structure" of a science, which is dependent upon unspoken ideological assumptions, and a kind of ideological superstructure that is built upon but is not logically entailed by the minimal structure (p. 47). We want to go on from here to study carefully and critically the writings of Haldane and Bernal.

Compare, for example, the first and third editions of Bernal's 'Science in History' and then look at the second edition of 1957, where he is half way to the bottom of a very graceful and self-forgiving climb-down from strong support for Lysenkoism. ON the other hand, genetics was constituted at all levels by fatalistic, biologistic, competitive, individualistic, elitist assumptions (which is not to say that its findings were 'false'). Much of the Lysenkoist rhetoric about western genetics as a social rationalisation was a fair cop.

Here are a couple of bits quoted by Medvedev: 'Weissmannism-Morganism serves today in the arsenal of contemporary imperialism as a means of providing a "scientific base" for its reactionary politics.' It disarms practice and orients man toward resignation to the allegedly eternal laws of nature, toward passivity, toward an aimless search for hidden treasure and expectation of lucky accidents... This "theory" leads to a passive contemplation of supposedly eternal phenomena of nature, to a passive expectation of accidental variation' (pp. 117-121 Columbia edn.). A paper published in this period was entitled 'Mendelislist-Morganist Genetics in Defence of Malthusianism'.

It may sound quaint and shrill until we reflect on the unbroken history from Malthus to the present of using the struggle for resources as a rationalisation for hierarchical and authoritarian social structures. As soon as there was a science of biology (term coined 1809) it took a central place in that history: social Darwinism, imperialism, racism, IQ, Nazism, and, of course, the current issues of XYY chromosomes and of sociobiology. It was as ideologically interesting and relevant for the Soviets to criticise biologism in the West as it is for us to look closely at the capital (pun intended) made by western ideologues out of exposing the scandal of Lysenkoism, e.g., Darlington, Zirkle, Huxley. It is also worth recalling that the Lysenkoist rhetoric against bourgeois scientific and agricultural workers was perfectly paralleled in exactly the same period (1948-52) by American McCarthyite anti-communist witch-hunting directed against intellectuals and cultural workers, thousands of whom lost their chosen livelihoods (Symonds, p. 27; cf. Hellman).

I am suggesting that there are six domains of writing which constitute a single problem of study for serious Marxists: bourgeois and Soviet biology, the generalisations seen to flow from them in the two camps, and the ideological critiques which each makes of the other's putatively 'ideological distortions' of science. The problem for study is the intertwining of these aspects of inheritance, which are seen as scientific and ideological on all sides.

Going further, these debates were as active in Russia and the USSR as they were in the West. We must look just as closely at their debates about the mechanism of evolution (e.g., Mikulak's work) as Lewontin & Levins advocate we look at the internal scientific debates in the current period (and for which they give very helpful references). It is worth pointing out that throughout the period Darwin's mechanism of natural selection was not an agreed orthodoxy in the West. Nordenskiold's standard History of Biology considered it discredited in 1928 (p. 476), while the founding work of the modern era, Julian Huxley's Evolution: The Modern Synthesis , appeared in 1942. The Soviets had other things on their plate in 1942 and – thanks to the West – continued to do so for some time. I'm not defending Lysenkoism or claiming that Soviet science was backward. In fact, before the advent of Lysenkoism it was very advanced. I'm just saying that debates on the mechanism of evolution remained open for longer than people who know little history of science tend to be aware of.

Lysenkoism (as Joravsky convincingly shows) was not derived from Lamarckian ideas of the inheritance of acquired characteristics. But it was compatible with them, while they were very attractive in some respects to Soviet creators of a new humanity. So it is very relevant that a young Bolshevik named Stalin had written in 1906 that neo-Lamarckianism was supplanting neo-Darwinism and that this proved once more that the Engelsian law of the dialectical transformation of quality was correct (Coulter, p. 150). Lysenkoist abandonment of natural selection began before this was unearthed and published in 1946, but the synthesis of Lysenko-Lamarck-Stalin's endorsement proved significant (Joravsky, p. 391 n144). In his triumphant 1948 speech Lysenko frequently identified his views with the Lamarckian tradition (which had been made a 'bogey' by neo-Darwinists), for example, 'the well-known Lamarckian propositions, which recognize the active role of external conditions in the formation of the living body and the inheritance of character acquired by plants and animals in the process of their development is possible and necessary' (Safonov, p. 523). Lest we feel complacent about such alliances and patronage (or the lack of it), we should reflect on the history of these complex issues in the West from the treatment of Mendel to that of Velikovsky.

Lewontin and Levins also have a section on 'The Reaction of the Peasants to Collectivisation' which I would like to underline. If there was ever a case of a society evoking the science it needs it was the situation in Soviet agriculture in the late 1920s. Lysenko was not primarily a geneticist but an agrobiologist – someone who was attempting to improve crop yields through a variety of techniques and nostrums known collectively as 'vernalisation' (e.g., soaking and then freezing them before planting so that they will sprout more quickly) and falling under a general rubric of influencing the organism by influencing its environment – hence the affinity with Lamarckian attitudes about nature.4 But why was there such tremendous pressure in this area of applied science? Not only was
there an acute problem of feeding the growing urban proletariat, but there was also – and of greater
long-term significance – a need for agricultural surpluses to export in order to provide the capital
for primitive accumulation and the development of heavy industry. Stalin spoke of the necessity to
'impose something like a "tribute" on the peasantry to support the country's industrialisation'
(Sweezy, p. 13). The resistance of sections of the agricultural population in the face of this policy led
eventually to forced collectivisation. Because of the internal situation, the failure of socialist
revolutions abroad, the consequent embattled isolation of the Soviet Union and the urgent need to
build socialism in one country, miracles were needed in agriculture.

E. H. Carr has pointed out that the general sense of urgency on the subject of generating grain
surpluses from 1927 was heightened by the international crisis and the war scare of that year
(resulting from disaster in China and the breaking off of relations with Britain). Attention became
focused on the need for rapid industrialisation and for development of the heavy industries which
were the basis for military strength (Pollitt ms., p. 45n). Thus, on the issue of agricultural yields
depended 'the very survival of the revolution and the very possibility of building socialism' (Dobb,
1967, p. 141). In some way the political and economic constraints on the extraction of the
agricultural surplus had to be overcome (Pollitt ms., pp. 44-5).

It is clear from the documents that fatalistic versus voluntaristic approaches to nature – especially to
biology – lay at the heart of the debates on planning. It was a controversy about whether or not
Malthusian constraints could be overcome by revolutionary struggle, and it was expressed in
biologicist terms of 'geneticists' versus 'teleologists'. 'The "genetic" versus "teleological" discussion
contained within it, of course, the seeds of the ancient and infinitely wide debate as to the
circumstances in which human will could or could not conquer "objective" obstacles' (Pollitt ms., p.
30, citing Dobb, 1967, pp. 161-163). The geneticists emphasized the constraints imposed on
planned economic development by the mode of production at the moment of plan implementation,
while the teleologists stressed the freedom conferred upon the planner by the very process of
planned development itself (Pollitt ms., p. 29). One of those stressing the constraints on planning
imposed by the existing mode of production, the 'geneticist' Groman, wrote, 'Even the greatest of all
revolutions – the October revolution – cannot change economic forms overnight'. But Stalin
declared against this assumption in a speech entitled 'On the Grain Front' delivered to students of
the Institute of Red Professors of the Communist Academy and the Sverdlov University in 1 May
1928. Pollitt calls this 'the crucial politico-economic document of the period'. Stalin addressed
himself to the fact that while crop area and gross production had reached the pre-war level, only
half of the pre-war amounts were available for market and only 5% available for export. The answer
was that many of the peasants were eating the surplus. The small scale peasant farmers had
traditionally consumed 85% or more of their production, and they were producing over 80% of the
country's grain – and eating better (pp. 33-4). Stalin set his face toward eliminating the 'genetic'
constraints on the extraction of the agricultural surplus at virtually any cost so that the capital
generated from export could finance the growth of heavy industry (pp. 44-5). His resolution of this
debate led to the forced collectivisation of agriculture, a programme which Carr calls 'probably the
most significant, and certainly the most revolutionary, decision taken by the regime in the first fifty
years of its existence'.

The other side of the historical significance of these events is reflected in Sweezy's argument that
'the forced requisitioning of 1927-1928 followed by the forced collectivization of 1928-1929
effectively destroyed the [worker-peasant] alliance and barred the road to the socialist development
of Soviet society' (Sweezy, p.11). By 1932, 60% of peasants were collectivised. The slaughter of
people by the authorities, and the killing of stock and the sequestration and destruction of crops in
protest, were the greatest willed destruction, within a country's own borders, of modern times.
That's the context of Lysenkoist efforts to improve crop yields.

Turning now to the question of Lysenko's peasant background, we find another extremely moving
and illuminating issue. In the same way as the peasant farmers were essential but resistant, the
bourgeois experts posed a problem. In order for the fledgling regime to have any hope of survival,
Lenin had early made a decision to compromise with the bourgeois experts of the tsarist regime, including bureaucrats, scientists and technologists. There weren't, after all, that many about, since plans for Russian industrialisation had only been coherently conceived by Witte in 1900, by which time Russia was producing just 5% of the world's manufactured goods (von Laue, p. 270).

We marvel at the position and power attained by the ignorant, blustering and opportunist Lysenko but may not notice that he was also devoting all his energies to the revolution. This doesn't mean that it was right to give him his head in all matters agronomic (much less biological and medical), but we should see that power in the light of the loyalties of the other available personnel. Lewontin & Levins write, 'The suspicion of the more academic "pure" scientists, including most geneticists, arose in part from their actual histories. Most of the senior scientists of 1930 had been members of the intellectual middle classes of pre-revolutionary Russia. Many had favoured the February revolution but had strongly opposed the Bolsheviks. Men like [the eminent biologist] Vavilov, who was enthusiastic about the socialist revolution from its early days and who displayed a great enthusiasm for the possibilities of science and agriculture in the new society, were no exception. Nevertheless, most agricultural specialists and scientists were kept on in responsible positions because the state seemed to have no choice. Not only in science, but in all branches of technology and management, unsympathetic managers and technicians had to be employed in socialist enterprises if there was not to be a complete breakdown. Soviet authorities were conscious of the difficulties of such a procedure and the position of such pre-revolutionary holdovers was problematical.

'In contrast, Lysenko represented the Russian equivalent of the "horse-back plant breeder", coming from peasant origins and receiving the bulk of his technical training after the revolution. Over and over again the polemic of Lysenkoist and anti-Lysenkoist contrasts are the "priests" of "aristocratic and lily-fingered" science with the "muzhik's son" who is "illiterate" and "ungrammatical". This contest between the effete middle-class intellectuals, and the close-to-the-soil practical agronomists was subtly extended to include a conflict between theory and practice, a vulgarisation of Marxism. In every aspect the conflict in agriculture was a revolutionary conflict, posing the detached, elite, theoretical, pure scientific, educated values of the old middle classes against the engaged, enthusiastic, practical, applied, self-taught values of the new holders of power. That is why Lysenkoism was an attempt at a cultural revolution and not simply an "affair" ' (pp. 50-51).

This change in science was part of a general policy, including collectivisation, of 'revolution from above'. Proletarian writers were promoted over fellow travellers, teleological planners over geneticists, red specialists over bourgeois specialists (Cohen, p. 333, citing Joravsky's Soviet Marxism and Natural Science). That is, people who sought autonomy from political control were replaced by people who did not, and Lysenko did not (Symonds, p. 9). For all its odiousness, Stalinism had within it three congruent struggles which are central to the construction of socialism: the rejection of bourgeois economistic fatalism (which was at the centre of Marx's Capital and rightly at the heart of socialist planning), the rejection of biologistic fatalism, and the removal of the recalcitrant experts whose scientism retarded socialism. In this sense, Lysenkoism points to a problem which must be faced by any revolutionary movement which is attempting to socialise knowledge and dismantle the hierarchical division of labour (which I would not, of course, claim the Soviet authorities were centrally doing). It went terrifyingly wrong (and even that phrase borders on obscene understatement), but it merits the closest scrutiny, for its aims were a far cry from the mere boosting of sycophants. Just as the experiences of the Spanish anarchists should be mined for important historical lessons, the writings of Joravsky and Graham invite re-sifting in the service of socialist struggle.

An analogous story can be told about Soviet xenophobia. Some of the bases for this in the ideological aspects of western biology have already been mentioned. With their characteristic gentle perceptiveness, Lewontin & Levins write, 'It would not be correct to interpret the anti-foreign hysteria of the late pre-war and early post-war periods as a simple revival of Russian nationalism. Rather, it represented a new, typically socialist form of xenophobia derived from a distorted
appreciation of real problems. Scientists in the newly post colonial countries are very aware of the need for intellectual independence. They recognised that the Western hegemony of science is an instrument of domination. They are aware of the dangers of an excessive regard for established centres of science which leads to the illegitimate transfer of techniques, reinforces the hierarchical, elitist social structure of science, and fosters the ideology of neutral technocracy. In this context, the lesson of socialist xenophobia is not that socialist scientists should return to the fold of the international (largely bourgeois) community of science as the only alternative to a Lysenkoist rampage. Rather, it leads to the demand for a programme of active evaluation and selection of those aspects of foreign science which can be incorporated into the construction of socialist science and a militant resistance to scientific colonialism. This requires a total rejection of the simplistic bureaucratic dogmatic Marxism which sees only the unity of phenomena and therefore equates the philosophy, scientific content, social context and political ideology in foreign science without seeing the heterogeneity and contradictions in it. Ideologically, it means a reaffirmation of dialectical analysis, and this in turn depends on free discussion without administrative fiat' (pp. 53-4). It must not be forgotten that bourgeois ideology in all its forms, capitalist economic strangulation, repeated – and on the last occasion massive – invasion, the with holding of a Second Front, nuclear blackmail and the Cold War gave the Soviet Union a legitimate sense of xenophobia. Coupled with the failure of communist movements abroad, the doctrine of an embattled socialism in one country, followed by offensive and defensive imperialism, is at least unsurprising.

Inside the Soviet Union a great transformation was going on. The voluntarism of the dedicated, hard-working Stakhanovites in coal mining and industrial production invited parallel achievements in altering nature. The Lysenkoists were known as 'agricultural Stakhanovites' and constituted a very special and privileged social stratum – cadres of agricultural production in state farms and breeding stations. Lysenkoism became 'the systematic form of the ideology of this social stratum' (Lecourt, p. 76). Michurin and Lysenko saw plant experimentation as conscious transformation of nature. Lysenko recited to the Soviet public these words of the man whose name was given to the agro-biological movement – Michurinism: 'It is possible, with man's intervention, to force any form of animal or plant to change more quickly and in a direction desirable to man. There opens before man a broad field of activity of the greatest value to him.' By the time of Lysenko's ascendancy in 1948, the slogan 'the transformation of nature' became the basis of a whole programme (Graham, 1971, pp. 234, 235, 237).

Just how far this went is clear from a remarkable contemporary document which is by turns ludicrous and chilling. Land in Bloom by V. Safonov is a popular history of agrobiology from Linnaeus to Lysenko which won the Stalin Prize in 1949 (a copy turned up in a Communist Party book sale in 1977 – I've never seen it mentioned in the literature). It is said that an inspiring slogan of the Chinese revolution (also of 1949) was 'Throw off Nature's insolent yoke!' Remarks on the new Soviet agrobiology strike the same note:

It was as if the fetters that had hound the ancient science of life had been broken The profound and exact understanding of living phenomena took the place of lifeless dogmas, reservations and biased interpretations. And so irrefutable was the effective power of this understanding that all the best representatives of biology, irrespective of the opinions they had formerly held, became convinced that the old views could he adhered to no longer.

This is what happened under our eyes. we are proudly conscious of the fact that it could have happened in no other country but ours.

A revolution in the world-wide development of biology has been brought about. We are witnesses of it.

The storm will subside and the new knowledge will then stand out, cast in beautiful and perfect mold. It will appear majestically calm; and the patina of time will also cover the struggle and victory of those fearless innovators, the scientists of our day
We, the Soviet people of the Stalin epoch, have seen how, in one of the biggest ideological battles fought in the history of natural science, a science of unprecedented might was born, and how this might endows man with fabulous power over nature. And a obstacles that only yesterday had been proclaimed fatally insurmountable, fall before it.

It is the science of life which teaches man how to transform the surrounding world and to re-create living nature. It is soviet, Michurin agrobiology. Its features are unexampled. It is the science of the people (Safonov, p. 13).

The combination of the rhetoric of class struggle, sycophancy and xenophobia is a common theme in the representation of the crucial 1948 Session of the Lenin Academy of Agricultural Sciences at which Lysenko achieved the peak of his power:

Partisanship in philosophy is the chief orienting factor... Only on the basis of the teachings of Marx, Engels, Lenin and Stalin can science be fully reconstructed.... Man is a part of nature, but he must not merely outwardly contemplate this nature.... The philosophy of dialectical materialism is an instrument for changing this objective world; It teaches how to influence this nature and to change it; but the proletariat alone is capable of consistently and actively influencing and changing nature – this is what the teachings of Marx, Engels, Lenin and Stalin – those unexcelled titanic minds tell us."

Every Michurinist applies these splendid words directly to himself and to his work to the struggle he is waging against the advocates of pseudoscientific formal genetics, the offspring of slavish subservience to Western ideological biology, of cosmopolitan worshipping of the idol "world science". (Safonov, pp. 529-530).

It is difficult to imagine that there is an honest Soviet scientist today who does not realize the objective significance and ultimate goal of the reactionary, thoroughly idealistic theory of formal genetics that had been imported into our country by the servile worshipers of things foreign (p. 539).

The final passage conveys the ghastly apotheosis of the unification of undemocratic centralism and a new, covert elitism with the desire to place science in the service of the people in transforming living nature:

The President of the Academy said: "Progressive biological science owes it to the geniuses of mankind, Lenin and Stalin that the teaching of I. V. Michurin has been added to the treasure house of our knowledge, has become part of the gold fund of our science."

He concluded his speech with a tribute to the Michurin science, the science of the transformation of living nature for the benefit of the Soviet people, with a tribute to the Party of Lenin and Stalin which revealed Michurin to the world and created in our country all the conditions for the efflorescence of advanced, materialist science

And when he uttered his final words: "Glory to the great friend and protagonist of science, our leader and teacher, Comrade Stalin!" the thousand or so people who filled that vast hall rose like one man and stood for a long time clapping, the sound of applause now rising and now subsiding, only to break out with renewed vigour.

In that same month, August 1948, the Presidium of the Academy of Sciences of the USSR, at a three-day enlarged session, discussed the results of the session of the Lenin Academy of Agricultural Sciences of the USSR: and the supreme scientific body in our country arrived at the conclusion that the development of Michurin science must become the pivot of all the natural sciences.

As a result, the work of our universities, of the vast network of scientific institutes research laboratories and plant-breeding stations that stretches over our country, was quickly reorganized. An unprecedented wave of enthusiasm swept through the ranks of our agrobiologists, soil scientists, agronomists, zoo technicians, academicians and advanced kolkhozniks [collective farm-workers].
The great festival that had been spoken about at the session appeared to have arrived... (pp. 541-542).

Not a small group of scientists, but the entire country was promoting Michurin science, the science of man’s power over the land and of the transformation of the land for the benefit of the people.
It was a revolution in science (p. 542).

**Conclusion**

I hope that I've said enough to make plausible the claim that in order to gain the benefits promised by Lewontin and Levins' opening up of this issue, we must go a long way further into the history of Lysenkoism as social relations. In particular, working scientists who want to theorise these issues must look as deeply into the historical, ideological and Marxist literature as they do into the putatively 'scientific'. On the historical front, I made the following list in the midst of my own attempts to make some sense of it: (I) revolution from above, (2) the perceived need for rapid industrialisation, (3) collectivisation, (4) cultural revolution, (5) need to overcome the attitudes and wrecking of kulaks and bourgeois experts, (6) 'on the grain front', (7) war scare of 1927, (8) cold war, (9) xenophobia. I leave this list raw and without further explication in order to highlight the stark unfamiliarity of the sorts of issues which we need to learn to see as relevant to a Marxist understanding of this episode in the history of science as ideology and political economy.

On the history of science front, we need to look much more deeply into the issues as seen at the time: scientific debates on Darwinism, Lamarckianism, natural selection, Mendelism/ Morganism and into the inextricably interwoven debates on social Darwinism, race, intelligence, imperialism: the second aspect of the ideology of nature. A Marxist history of science is not merely a review article pushed farther back in time; it is a different kind of history. We have our own reasons for looking at the continuing history of sociobiology and our own motives for considering the ongoing debates on the meaning and mechanisms of evolution and why planners and ideologues should be interested in them. We need to reconnect with the history of the debate over scarcity and social conflict in which Marx and Engels played – and continue to play – a central critical role. It is a broadly-based and ongoing interaction of theory, practice and rationalisation over the limits nature may or may not set to human equality and achievement and how to conceive of and work on the relevant 'realities'.

The aspect we don't need to be told any more about is the abuse of power in a bureaucratic state, though I would argue that orthodox Marxists are exceedingly slow to draw the conclusions that emerge from the history of democratic centralism.

If we could fight off the complacent liberals – East and West – who use Lysenkoism as a self-congratulatory object lesson to reinforce their own elitism and false consciousness about the autonomy of the content of science, and if we could fight off the scientism of both vulgar and 'rigorous', theoreticist, structuralist Marxists, we could use Lysenkoism to learn more and more about the single domain of enquiry which is artificially analysed as

- science and pseudoscience
- science and ideology
- science and society
- science and economy
- science and politics
- science and power

If we could win those fights, then the integration of these domains with Marxist exegetics and with struggles in our own situations would be less mystified, would be enriched, and the appeal of a pluralistic conception of revolutionary struggle would be increased. The forces and issues raised by Lysenkoism do not teach us how different our science is but how like the interpenetrations
constituting Lysenkoism are the sciences in our own scientistic society. Along with Fidel Castro's critical and self-critical '26th of July' (1970) speech, it also shows how complicated, refractory and daunting are bourgeois hegemony and its metaphysical citadel, conceptions of nature. (In that speech Castro shows in detail and very evocatively just how tangled is the task of dismantling one socio-economic order in order to build another.) Finally, Lysenkoism provides a very striking example of how an epoch calls up the science it requires – how base, superstructure and mediations interact and interpenetrate even in a society which has the strictest controls on intellectual (including scientific) – production.

I once tried to give a paper at a conference in Moscow which mentioned ways of learning from the Lysenko period as part of an argument about science and mediation. I was not allowed to finish, even though I had made special arrangements to make sure I had enough time and had practised the talk with a stopwatch. In the question period a very assertive person said, quite dogmatically, 'There are no mediations'. I thought him a very vulgar Marxist, but he came up to me afterwards and said that his bombastic intervention was a sick joke send-up of the setting and the fact that I had been cut off. Then, just as he was turning to leave, he said, 'I'm a Yugoslav, you see'. (In other words, there are no mediations in the Soviet Union.)

The situation in the Soviet Union had dictated that the pure and applied sciences in the biological and agricultural spheres would reflect the needs of industry. The relationship was a crude, coerced one-to-one correspondence. At the other extreme lies the conception of the relative autonomy of science and the scientific mandarinate – a position shared by Vavilov, the Royal Society, its counterparts in other Western countries and by current theoreticist Marxists. We must somehow elaborate theory and practices of a mediated relationship which struggles toward the production and reproduction of socialist social relations. The study of the Lysenko episode through socialist eyes is very likely to help us in that work.

Proletarian Science?

After I had drafted the foregoing commentary on Lewontin and Levins' essay, an important translation appeared which moves the argument along in significant ways: Dominique Lecourt's Proletarian Science? The Case of Lysenko. I shall try to provide a succinct evaluation and to connect it with the project outlined above. Lecourt offers a sympathetic exposition and critique of the political economy and ideology of the episode, which is particularly relevant to the critique of technicism and scientism within Marxism. More specifically, he explores the role of the ontological interpretations of dialectical materialism which lead from Engels' Anti-Duhring: Herr Eugen Duhring's Revolution in Science (1878, from which his Socialism: Utopian and Scientific is drawn) and his notes compiled as Dialectics of Nature (1873-1886) via Plekhanov to Stalinist versions of vulgar Marxism.

The following excerpts are offered to whet the reader's appetite:

This was perhaps the ultimate hidden motor of Lysenkoism, what gave it its strength and guaranteed its support: it had appeared at the right moment in response to a problem and a demand produced by a "technicist" economic conception and practice of the construction of socialism (p. 75).

This ensemble was not just the fruit of terror and corruption as Joravsky thinks, for example: it was the product of a determinate political line which, having posed the peasant question in unilaterally "technical" terms, had as a result encouraged a new type of social differentiation in the countryside between the "ordinary" kolkhozniks and the experts and technicians whose ideology crystallized around two successive slogans of Stalin's: "technique decides everything", and then "cadres decide everything". The "agricultural" form of this ideology was "Lysenkoism" (p. 77),

This is all relevant to the critiques of Marxist economism and scientism. But the debate on which the book bears most directly is that of how a society constructs its science and the relations of intellectual formations – including the deepest metaphysical assumptions of science – to the mode
of production and the history of the contradiction between the forces and relations of production (which is a project for investigation).

As early as 1950 the French debate on Lysenkoism threw up the following profound characterisation under the title, 'Science, a Historically Relative Ideology' by J. T. Desanti: 'That there is a bourgeois science and a fundamentally contradictory proletarian science means above all that science too is a matter of class struggle, a party matter.' And he asked: 'If science is the product of a class, how is one to understand the objectivity of its content? How is one to understand the undoubted unity of its development?' Answer: 'Science is the fruit of human labour and in this labour man determines nature as it is in itself. To transform the thing in itself into a thing for us means to attack brute nature with tools forged in contact with it and to learn by this labour to master it. Now, this transformation is not the work of man in isolation; it uses tools, it is achieved in labour. Hence it is the fruit of the whole society: the way it is achieved reflects the state of the productive forces that sustain the whole social edifice; and hence also the interests of the class whose social activity promotes the productive forces and sustains the form of organisation of labour. Hence the content of science must remain the dialectical unity of the two terms of this transformation: human labour on the one hand nature on the other. This unity is precisely what Lenin calls the "thing for us" or, in other words, the sector of nature already dominated for human practice. This dialectical relation must also be found in the development of science. The development always has a social content: as such it is always relative to the state of the productive forces, always linked to class struggles (often by remote links), always expressive of the interests and consciousness of a class. But this development thereby expresses the degree of mastery and domination that a given society has achieved over nature. It thus contains and uses, even as it extends it, the sector of nature already dominated. This explains how science can be one in its development and is yet linked by a necessary bond to class struggles; this explains how the content of science can be objective and yet express the viewpoint of the rising or ruling class.'

Lecourt comments,

'This text is undoubtedly the most systematic justification for the philosophical basis of Lysenkoism. It has the exceptional interest that it confronts the crucial philosophical questions posed by the theory of the "two sciences" without side-stepping: an imprudence from which the majority of Soviet philosophers were retreating at the same moment' (pp. 24n-25n).

Between that formulation and Lecourt's rejection of 'The theory of the "Two Sciences"' in chapter five lie the issues which Marxists must confront about science. Lecourt sets up the problem so that the only theory of the two sciences on offer is a crude one following from what he calls 'the ontological version of dialectical materialism' (p. 117), and he convincingly rejects that version (p. 112). But he ultimately releases his grip on the metaphysical issues about labour, practice and the labour process and reverts to the issues as represented by the writers on Lysenkoism whose views were rejected at the beginning of my commentary on Lewontin & Levins. The analysis reverts to the mediations of Stalinist power:

'I want to argue that, behind the mask of the generalization of Lysenkoism, proposed as ideology to all intellectual workers, order and register were being shifted. It was no longer a question of "scientific" or "philosophical" theory; in fact what was happening was the consecration of a state ideological system: a state ideology in which the "theory " of the two sciences is the crucial component – at once privileged instrument, functional model and theoretical "touchstone".

'In short, we can say of the final avatar of Lysenkoism, the one in which it found its final form and status, what we have said about the earlier ones: that an event seized on it from the outside to assign it a role in the Soviet social formation.

'Or else, if we wish to give these remarks the spice of paradox, we can say that the 1948 Session only officially consecrated the success of Lysenko's theories – brushing aside all the objections and taking all the risks – because it was no longer a question either of Lysenko or his theories but of
something quite different which had constantly been practised previously in partial forms and finally achieved its general and systematic form at that date: a declared, obligatory state ideology which imposed on all intellectuals the Stalinist version of dialectical materialism beneath the rule of the supposed antagonism of "bourgeois science" and "proletarian science" (pp. 122-123).

Lecourt is, of course, correct about those historical events, as the above quotations from Safonov's *Land in Bloom*, among numerous accounts, make clear. But in reverting to that aspect, he declines to address important issues raised for the construction of progressive struggle in scientific theory and practice. There is a whole tradition of socialist struggle in science, technology and medicine (I'm thinking at the moment of medical programmes in Tanzania, Vietnam and China and research in China and Cuba) which has attempted to break new ground. In the domain of theory, these issues have been formulated by a whole tradition which does not succumb to the parameters which Lecourt ultimately settles for (I'm thinking of Lukács, Korsch, Gramsci, Marcuse, Williams, Thompson and other writers listed in the *RSJ* reading lists on 'Science, Ideology and the Labour Process' and on 'Marxism and the Critique of Scientism' [RSJ 6/7, pp. 144-50]).

The challenge is to transform and deepen studies such as those of Lewontin & Levins and Lecourt in the service of the understanding and transformation of the relations between modern societies and their intellectual formations conceived as labour process and practice, that is, in terms which do not lead down vulgar-Marxist, theoreticist or idealist alleys. An historical epistemology for socialist praxis which neither reduces the relations of production to the forces of production (as in technicism) nor debases the base as merely the sphere of production. The ultimately determining element – 'the last instance' – was considered to be much richer than that, even by Engels: 'According to the materialist conception of history, the ultimately determining element in history is the production and reproduction of social life. More than this neither Marx nor I have ever asserted'. It is that rich conception to which we need to relate the understanding of science as social relations.

**Notes**

1. One earlier study, a review by Gary Werskey, was along promising lines while the translation of Dominique Lecourt's book, which appeared after Lewontin & Levins' essay, moves the debate along considerably. I have added a short commentary on it at the end of my remarks on Lewontin & Levins.

2. Some Maoist neo-Lysenkoist groups: Canadian Communist Movement, Necessity for Change Institute of Ideological Studies (Montreal and Dublin), and the journal *Serve the People*. The works of Lysenko and Michurin have been sold in the past few years by an English group which came to be called the English Communist Movement, now the Communist Party of England (Marxist-Leninist).


4. Lecourt, unlike Joravsky, gives a sympathetic account of Lysenko's practical work and its generalisation as 'the criterion of practice'. On vernalisation, he writes, "The term "vernalisation" (yarovizatsiya) is indisputably Lysenko's. The reality of the technique it designated initially predates Lysenko, as we shall see. It should also be noted that later on, Lysenko used the term in a much looser sense to designate any technique which brought a thermal factor into play in what he called the training of plants" (p. 39n).


On Stakhanovism, see Dobb, 1966, pp. 468-481.

An analogy may help to reduce our sense that the immense expenditure on Lysenko's unproven and inefficient techniques was merely bizarre. The pressing needs of a society can lead it to invest vast resources in a tremendously wasteful and unpromising method if its ruling class wants the desired product badly enough. The diffusion method used in the USA during World War Two to separate the isotopes of uranium (which differed in weight by just three subatomic particles) was incredibly inefficient and required the building of vast hydroelectric facilities at Mussel Shoals, just as the installation at Los Alamos and the overall dimensions of the Manhattan Project were profligate beyond previous dreams. But the authorities deemed the prize worth the effort and expenditure and the gamble worth taking. Improving crop-yields and generating a marketable surplus was far more obviously a matter of national survival to the Soviet Union than the possession of an atom bomb was to America (which is not to say that food can't become as powerful a weapon, as recent events have shown).

The following is rubber-stamped on the title page: "Russia Today Book Club" Not for Sale to the Public'.

For an interesting example of the lengths to which the mandarins of bourgeois science are prepared to go in attempting to demarcate science from its social and ideological constituents (thereby preserving existing arrangements) see Sir Andrew Huxley's Presidential Address to the British Association, 1977, and the ensuing exchange between him and me: Times Higher Education Supplement 2 Sept. 1977, pp. 4-6; 23 Sept., p. 5, 7 Oct., p. 27, 4 Nov., p. 27; see also his letters to New Scientist 29 Sept., p. 819 and Nature 29 Sept., p. 366. Sir Andrew is a Nobel Laureate, Fellow of the Royal Society and Royal Society Research Professor. He is going to bat for Jensen, Burt, Shockley and other biological fatalists and is using the Lysenko affair as a basis for mocking the Left.

We hope to publish a considered essay on it and related matters in a future issue of RSJ.

It is a paradox about Engels that he developed the theoretical basis for vulgar Marxism and extreme versions of dialectical materialism at the same time that he wrote a number of very helpful reflective letters on the need for a rich and more mediated conception of the relations between determination in the last instance by the mode of production and social, cultural and intellectual phenomena. See Marx & Engels, 1965, pp. 415-425, 458-62, 466-68; Young, 1973; Hall, 1974, 1977; Williams, 1977, esp. ch. on 'Ideology' and Part II on 'Cultural Theory'.

Appendix

Obituary: Trofim Denisovitch Lysenko (The Times 24.11.1976)

Professor T. D. Lysenko, the Russian geneticist hailed during the Stalinist era as having produced theories vital to Soviet agriculture, but later denounced as a fraud, died on November 20, (aged 78). Lysenko was born at Karlovka in the Poltava province of the Ukraine in 1898, the song of a peasant. After graduation in 1921 from the Uman School of Horticulture he went to work at the Belaya Tserkov Selection Station. In 1925 he graduated from the Kiev Agricultural Institute and moved to the Experimental Selection Station in Gandzha – now Kirovabad. In 1929 he became Senior Specialist in the Physiology Section of the Ukrainian Institute of Selection and Genetics in Odessa. By 1936 he had become its director.

At the institute he carried out some research on plant physiology which attracted little attention in the scientific world until about 1931 when he published his first works on the phenomenon of vernalization. It had been known for some time that winter varieties of wheat and other plants, which normally fail to bear ears and ripen their grain when sown in spring, will do so if they are
exposed to low temperatures, just above freezing point, for varying periods immediately after sprouting. Lysenko extended the knowledge of this phenomenon and built up from it both an elaborate hypothesis on development in plants, which came to be known as the theory of phasic development, and an agricultural method which enabled winter varieties of cereals and other plants to be treated with low temperatures and sown as spring crops. This technique came to be known as the method of vernalization, though why such importance has been attached to the conversion of winter to spring forms, when quite satisfactory spring forms of most crop plants already exist, has never been adequately explained. Be this as it may, much effort and many millions of roubles were expended in applying vernalization to the cereal crops of the Soviet Union. Official accounts of the success of these experiments vary, claims having been made of vast increases in grain yield. Later more critical reports from official sources and from foreign visitors suggest that, except in exceptional circumstances, little advantage has accrued and the yields were in fact often impaired.

Lysenko, however, was undismayed by his critics. In fact he even went as far as to extend his theory. The conversion of winter plants to spring or vice versa could, he claimed, become hereditarily established if carried out under suitable conditions, though the exact conditions were never defined in unambiguous terms.

Here then was a new theory of heredity – or an old one in a new guise. For Lamarck's theory of inheritance amounted to just this – that attributes acquired during the lifetime of an individual are transmitted to its progeny. Though thousands of experiments carried out by geneticists all over the world have rarely if ever demonstrated any such transmission, Lysenko's views on heredity proved popular with farmers and country folk, who have ever had such ideas close to their hearts, and, what is equally important, to the administrators and politicians; for Lysenko's ideas conformed more closely with Marxist principles of equality than did those of the geneticists who believed, it was said, on an aristocracy based on genes, hence in racialism, fascism, imperialism, colonialism and other dreadful things. Lysenko's ideas also fitted well with those of I. V. Michurin, the veteran fruit breeder who was also an idol of the Soviet People.

However, some of the more enlightened biologists in the Soviet Union attacked Lysenko and his ideas in the early days, one of the most influential being the critic N. I. Vavilov, well known internationally for his studies on the origins of cultivated plants. Between the years 1934, when Lysenko's views on inheritance began to be widely known, and 1948 the voices of the critics were nevertheless gradually silenced. Lysenko was awarded the Order of Lenin and two Stalin prizes, and was nominated Vice Chairman of the Supreme Soviet; in 1938 he was appointed President of the Lenin Academy of Agricultural Science and in 1940 assumed the Directorship of the Institute of Genetics of the USSR Academy of Sciences.

Many other honours and appointments followed. The climax of his success came when, on August 26 1948, the Praesidium of the USSR Academy of Science passed a resolution virtually outlawing any biological work that was not based on the teachings of Michurin and Lysenko. Most of his remaining critics recanted at this same meeting. Others were removed from their official positions and some were arrested. This fate had already overtaken N. I. Vavilov in 1940 and nothing more was heard of him until his death in September, 1942. From this time until the death of Stalin in 1953 Lysenko ruled virtually supreme and his influence was felt not only in livestock breeding, animal husbandry and forestry but also in many fields far removed from plant physiology and genetics.

The period in question saw many further developments of Lysenko's theory. Plants of the same species were supposed not to compete with one another, and foresters, as well as farmers, were advised to grow their plants or trees in clusters for mutual aid. Plants were believed to 'assimilate' the environmental condition in which they were grown and intricate systems of 'training' were devised in order to influence the hereditary properties of young seedlings. One of the systems was to graft the seedlings on to another plant belonging to a different variety, species, or even genus and so the old belief in graft hybrids, current in earlier centuries, was revived. The fact that many of them had been shown by cell studies to be chimeras, or cell mixtures, rather than true hybrids, was
conveniently ignored by Lysenko, who had a singular capacity for overlooking facts that did not suit him.

(After Stalin's death Lysenko was subject to criticism, investigation, and eventually he was denounced as a fraud by Khrushchev, who ascribed no small part in the responsibility for the Soviet agricultural crisis to Lysenko's influence.)

Nevertheless, Lysenko was to find favour again, and at that with Khrushchev, for his researches into composting and breeding dairy cows with high butter fat, themes both dear to Khrushchev who wanted to raise the USSR's milk output. He regained a substantial measure of his old authority and was only finally forced to quit the Institute of Genetics with the ousting of Khrushchev himself.

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This is an inclusive bibliography of all the works in English which I consider relevant and have consulted or which I have been told are relevant (but it makes no attempt at comprehensiveness – see Graham, Zirkle, Joravsky for that, though they are also patchy and even silent on some topics). I am very unlikely to pursue the issues in this context and want to socialise the bibliographical information I've gathered from various sources over the years. Sources are a very serious problem for Marxists who try to work out a different perspective on issues in areas where they are not expert and/or don't speak the language(s). Noam Chomsky has shown, however, that it can be done in his essay on how Hugh Thomas and others treated the role of the anarchists in the Spanish Civil War. The expert, by the way, has completely rewritten the book, partly as a result of Chomsky's critical reorientation of the issue. (All works published in London unless otherwise specified.)

Thanks for extra items to Gary Werskey, Anthea Symonds, Dominique Lecourt, David Joravsky, and Colin Beardon, to Philip Boys and David Murray for their criticisms, to Brian Pollitt for guidance about the Soviet debates in the 1920s, and to the following for helping to formulate my thinking on this topic for the unpublished essay which was a precursor to this one: Brian Turner, Ingrid Lorch Turner, Margot Waddell, Gary Werskey, Jerry Ravetz and Mikulas Teich.


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Chapter 4 on Marxism in power for the first few pages of the chapter and conclusion sketches the circumstances of the October Revolution of 1917 and its consequences for intellectual life, particularly for philosophy and science. It deals with the relationship of the bolsheviks to both the old and new intelligentsia and the creation of new institutions, such as the Communist Academy, the Institute of Red Professors and the journal *Under the Banner of Marxism*. It then outlines the contending positions in philosophy of science and the politics of philosophy and science as the 1920s unfolded and moved into the 1930s. It turns subsequently to the particular sciences and analyses the debates within psychology, physics ... and then biology.

**The Biology Debate**

Things went very differently for Soviet biologists. In the 1920s, the debate was focused on the conflicting claims of genetics, as elaborated by such scientists as Mendel and Morgan, and Lamarckism, which was experiencing something of a resurgence.*

* Genetics was in its formative stages as a science in the early 20th century and was based on the experiments of such scientists as the Czech monk Gregor Mendel, the German August Weissmann, and the American T.H. Morgan. It located the transmission of heredity in the genes - particulate, material, self-reproducing, intracellular units, which functioned as carriers of inheritance. Mutations occurred spontaneously by random selection. In this way, it accounted for both the relative stability and the variability of species. Lamarckism, derived from the work of the French scientist Jean-Baptiste de Lamarck, who sought to explain the mechanism of evolution, came to stand for the belief that transformation of species occurred as the result of many individuals simultaneously adapting to common environmental stimuli.

At first, many Soviet biologists were favourably disposed towards both. They discerned in genetics the material basis of individual heredity, but they believed that it was inadequate in explaining the evolution of the species or the influence of the environment in the process of evolution. Lamarckism was viewed sympathetically as answering these supposed inadequacies.*

*There did seem to be something of a tension between genetics and evolution early in the century, as genetics seemed to emphasise stability at the expense of development. However, as the science developed and as the process of mutation became clearer, its explanatory power broadened.

Research was carried on by experimenters of both orientations. The Timiriazev Institute was a centre of Lamarckist research. The Communist Academy offered a laboratory to the Austrian Lamarckist Paul Kammerer in 1925**

**Kammerer accepted the post. However, returning to Vienna for his books and equipment, he was confronted with evidence of fraud in one of his crucial experiments, and shot himself. Cf. Arthur Koestler's biography of Kammerer, *The Case of the Midwife Toad* (London, 1971).
Meanwhile, the geneticists pursued their research as well. Some, such as B.M. Zavadovsky and K.A. Timiriazev, argued for the compatibility of Morganist and Lamarckist assumptions and urged a reconciliation of the two points of view. In a series of discussions held at the Communist Academy in the late 1920s, militant Morganists, such as A.S. Serebrovsky, I.I. Agol, and N.P. Dubinin, argued forcefully against any such reconciliation. They insisted on the absolute irreconcilability of Morganism and Lamarckism.

The key question was that of the inheritance of acquired characteristics. Lamarckists cited Engels on their behalf. B.M. Zavadovsky and others of his persuasion replied that they could not be tied to outdated science and had to break with belief in the inheritance of acquired characteristics, even if this meant abandoning views held by Marx and Engels or Darwin and Timiriazev.

Lamarckists accused Morganists of undermining scientific determinism by reducing evolution to accident and chance. Morganists replied with charges of anthropomorphism and argued that their picture of evolution as random, undirected mutation was the surest defence of scientific determinism against the revival of teleology. Zavadovsky noted nonetheless that in the mid-1920s voices in favour of Lamarckism were growing louder and stronger, as he had good reason to know, for he had been challenged by his students at Sverdlov Communist University who considered genetics to be a "bourgeois science."

At the April 1929 conference of Marxist-Leninist scientific institutions, Morganists linked Lamarckism with mechanism and pushed for a formal repudiation of Lamarckism, as well as of mechanism. In this they were not successful. Nevertheless, Morganism most definitely had achieved the edge in the biological debate. Agol and others asserted confidently that Morganism was the realisation of dialectical materialism in biology. They established in the minds of many a connection between Morganism in biology and Deborinism in philosophy. This was to their advantage in the period when Deborinism was at its moment of victory, but it was not a factor in their favour when the latter came to be labelled "menshevising idealism."

In 1930, however, both Morganism and Deborinism were in the ascendant. At the all-union congress of biologists in that year, Morganists announced that Lamarckism was in conflict with Marxism by virtue of its teleological character, whereas dialectical materialism was implicit in the science of genetics. This group included not only the biologists Agol, Serebrovsky, and Levit, but also the philosopher Prezent, shortly to become one of the harshest and most implacable opponents of genetics.

One somewhat confusing aspect of this debate was the fact that Lamarckism was repeatedly identified with both mechanism and vitalism. Perhaps on the part of some authors this could be put down to overly facile and superficial labelling. Zavadovsky's remarks on the tendency of these two extremes to pass into one another in his 1931 paper at the history of science congress in London, however, offered some justification for it. The theory of evolution, Zavadovsky further argued, was passing through a crisis that could not be solved by any eclectic reconciliation. The Lamarckian man-in-the-street explanation of heredity had the virtue of simplicity, but it was a simplicity that had been outgrown by science. Heredity could now receive its true explanation only according to the more complex formulae of Mendelism and Morganism. He did, however, take exception to the autogenetic enthusiasm of those geneticists, who altogether ignored the influence of external environment.

Aside from the references to dialectical materialism, the debate among Soviet biologists developed along lines parallel to the debate among biologists elsewhere. Everywhere Lamarckism was losing ground to genetics in response to the mounting experimental evidence. The turning point in the debate came in 1927 with the highlight of the 5th international congress of genetics in Berlin, the announcement of H.J. Muller's discovery of methods for artificially producing mutations. This discovery, as Serebrovsky excitedly announced in his September 11, 1927 Pravda article entitled "four pages that shook the scientific world" was thought to be the decisive blow to Lamarckism.
The debate continued, but the balance had shifted. V.L. Komarov, the vice-president of the Academy of Sciences, was typical of his generation of biologists with Lamarckist sympathies who were becoming more and more critical of Lamarckism and more and more favourably disposed towards genetics. He began to remark on the poverty of Lamarck's factual material and on the predominance of deduced conclusions and to stress the importance of starting from the facts and combining inductive and deductive methods.

Both Lamarckists and Morganists were at this time claiming unto themselves the mantle of proletarian science. Lamarckists asserted that their position meant that the working class were not slaves of the past but creators of the future. Morganists replied that the persistence and resisting power of hereditary characteristics was more in the interests of the working class as it explained the survival of their human potentialities through generations of poverty, underfeeding, and, generally, the most unfavourable external conditions. Such arguments, however, were not unique to the Soviet debate, but were a feature of the discussion elsewhere as well.*

* In an article entitled "Science and Values: The Eugenics Movement in Germany and Russia in the 1920s" Loren Graham shows that there were in the 1920s Marxists who were eugenicists and those who were Lamarckists, as well as anti-Marxists among both groups. A decade later this situation in both countries was replaced by one in which genetics and eugenic theories were linked to conservative political views, and Lamarckist theories were linked to left-wing political views. (The American Historical Review December 1977).

However, about this time the Soviet debate was set along an altogether distinctive path by an entirely new factor. The militant bolshevisers were demanding that biology, like every other science, be reconstructed on the basis of dialectical materialism. The tendency was to assume that both Lamarckism and Morganism were foreign and therefore bourgeois and needed to be replaced by a new, distinctively Marxist and thoroughly proletarian biology that would transcend both Lamarckism and Morganism.

B.P. Tokin, embryologist and director of the Timiriazev Institute declared that Marxists must stop tailing along behind bourgeois science and create "a single Marxist-Leninist school in biology." As to what such a school would be like, there was only the vaguest idea, but there was a certainty that it would prove itself by its relevance to the tasks of social construction, particularly by its practical service to Soviet agriculture.

There were heady proclamations about the indissoluble unity between Soviet biological science and Soviet agriculture, but no new theoretical breakthroughs. There was much groping, but no sign of a specifically proletarian biology. Most working biologists continued to accept the same assumptions as their foreign colleagues and in doing so were in fact conscientiously serving Soviet agriculture. Serious work in genetics was proceeding and compared favourably with the state of research anywhere else.

And then onto the stage stepped Lysenko.

TD Lysenko (1898-1976)
Lysenkoism

Trofim Denisovich Lysenko was a young agronomist from the Ukraine, who first came into the limelight in 1927 in connection with an experiment in the winter planting of peas to precede the cotton crop in the Transcaucasus. His results, in his remote station in Azerbaijan, were sensationalised in Pravda. The article projected an image of him as a sullen "barefoot scientist" close to his peasant roots.

Lysenko subsequently became famous for the discovery of "vernalisation," an agricultural technique that allowed winter crops to be obtained from summer planting by soaking and chilling the
germinated seed for a determinate period of time. He was the first to use the term "vernalisation," but not in fact the first to discover this technique, as N.A. Maksimov was quick to point out. Lysenko ignored previous studies of thermal factors in plant development and reacted angrily to Maksimov's claim to scientific priority and to his criticisms of Lysenko's experimental techniques.

After being overshadowed by Maksimov at the all-union congress of genetics, selection, plant and animal breeding held in Leningrad in January 1929, Lysenko organised a boisterous campaign around vernalisation, and made extravagant claims based on a modest experiment carried out by his peasant father. The Ukrainian Commissariat of Agriculture, in the hope of raising productivity after two years of famine, ordered massive use of the vernalisation technique. Lysenko was moved to a newly created department for vernalisation at the All-Union Institute of Genetics and Plant Breeding in Odessa. There he began to publish the journal *Yarovizatsiya* (Vernalisation) in which he disseminated his ideas on a wide scale and created a mass movement around vernalisation.

The next stage in Lysenko's career came when, from 1931 to 1934, he began to advance a theory to explain his technique. According to the idea of the phasic development of plants, a plant underwent various stages of development, during each of which its environmental requirements differed sharply. The conclusion Lysenko drew from this was that knowledge of the different phases of development opened the way for human direction of this development through control of the environment. It was a very vague theory, never to be spelt out very fully, but it provided the link in the evolution of Lysenko's platform from a simple agricultural technique to a full-scale biological theory.

The underlying theme was the plasticity of the life cycle. Lysenko came to believe that the crucial factor in determining the length of the vegetation period in a plant was not its genetic constitution, but its interaction with its environment.

Lysenko's theory developed in a pragmatic and intuitive way as a rationalisation of agronomic practice and a reflection of the ideological environment surrounding it and not as a response to a problem formulated within the scientific community and pursued according to rigorous scientific methods. But the impression was created that Lysenko achieved results at a time when there was a great demand for immediate results and a growing impatience with the protracted and complicated methods employed by established scientists in achieving them.

Lysenko's fame as the sort of man who would achieve results continued to spread. With it came a sympathetic hearing for whatever theoretical views he chose to express, no matter how vague or how unsubstantiated. Lysenko's practical achievements were extremely difficult to assess. His methods were seriously lacking in rigour, to put it mildly. His habit was to report only successes. His results were based on extremely small samples, inaccurate records, and the almost total absence of control groups. An early mistake in calculation, which caused comment among other specialists, made him extremely negative toward the use of mathematics in science.

Contemporaneous with Lysenko's vernalisation movement was a growing interest in the work of Michurin, the last in the line of an impoverished aristocratic family in central Russia, who cultivated fruit trees and began experimenting with grafting and hybridisation. Michurin worked on the assumption that the environment exercised a crucial influence on the heredity of organisms and he queried the relevance of Mendel's "peas laws" to fruit trees. Michurin's name was soon to be seized upon by Lysenko to designate a whole new theory of biology in opposition to classical genetics, even though Michurin himself had no such theoretical pretensions. Nor was he so anti-Mendelist as
Lysenko began to make him out to be, for he did not hold to environmental influence on heredity to
the exclusion of a recognition of the internal genetic constitution of the organism. Indeed, before
his death in 1935, he began to acknowledge the validity of Mendelism.

Up until 1935, neither the agronomic experiments of Lysenko in vernalisation, nor those of
Michurin in graft hybridisation, were seen to have any direct bearing on the theoretical debate in
Soviet biology. Geneticists carried on with their work, although there was constant tension
surrounding it.

In 1931 and 1932, a number of geneticists were branded as "menshevising idealists" and lost their
positions at the Communist Academy. There was increasing pressure to abandon basic research that
was unlikely to lead to immediate practical measures that would advance Soviet agriculture and
there were strong implications that research in "pure science" was tantamount to sabotage.

A particularly vicious article that appeared in the influential newspaper *Ekonomicheskaya zhizn* in
1931 was directed against Academician N.I. Vavilov, founder and president of the Lenin Academy
of the Agricultural Sciences, director of its All-Union Institute of Plant Breeding, as well as director
of the Institute of Genetics of the Academy of Sciences. Vavilov was an internationally eminent
plant geneticist and an ardent advocate of the unity of science and socialism. The article, which
appeared with editorial endorsement, was written by a rather unsuccessful subordinate of Vavilov's,
A.K. Kol, who accused Vavilov of a reactionary separation of theory and practice and advised him
to stop collecting exotica and to concentrate on plants that could be introduced directly into farm
production.

Unrealisable goals were imposed on Vavilov's All-Union Institute of Plant Breeding in 1931 and in
1934 he was called in by the Council of Peoples Commissars to account for the "separation between
theory and practice" in the Lenin Academy of the Agricultural Sciences.

Lysenko was very much a part of this campaign, stirring up a negative attitude to basic research and
virulently demanding immediate practical results. He was capable of the crudest anti-
intellectualism, remarking on one occasion: "It is better to know less, but to know just what is
necessary for practice." He also was inclined to enunciations of the wildest voluntarism: "In order
to obtain a certain result, You must want to obtain precisely that result; if you want to obtain a
certain result, you will obtain it .... I need only such people as will obtain the results I need". Older
scientists were, of course, horrified at such talk, so utterly alien to the habits of mind in which
scientific method was grounded.

But Lysenko was the man of the hour, suited as he was to step into the role of the man of the people,
the man of the soil, who had come up from humble origins under the revolution and who directed
all of his energies into the great tasks of socialist construction. He knew well how to whip up
massive peasant support, how to woo journalists, and how to enlist the enthusiasm of party and
government officials. He began to be pictured as the model scientist for the new era. He was
credited with conscientiously bringing a massive increase in grain yield to the Soviet state, while
geneticists idly speculated on eye colour in fruit flies.

Lysenko made the most of this image and became more and more virulent in attacking geneticists
and contrasting their "useless scholasticism" with his own great "practical successes." He began to
speak of class struggle in science and declared in his speech at the 2nd all-union congress of shock
collective farmers in 1935 that "a class enemy is always an enemy whether he is a scientist or not." Stalin, who was present, exclaimed at the end of his speech "Bravo, Comrade Lysenko, bravo."

Another new stage began for Lysenko in 1935 when, no longer a simple practising agronomist
experimenting with a new technique, he came forward as herald of a new biology born out of Soviet
agronomic practice. He was assisted in making this leap through his collaboration with Prezent, a
party member*

*Interestingly, Lysenko was never a member of the Communist Party.
and specialist in educational methodology in the natural sciences who had philosophical training and who was extremely adept at the sort of ideological demagoguery that was beginning to flourish among a certain section of the younger intelligentsia. It is likely that Prezent brought Lysenko to see the ideological possibilities of his vernalisation movement.**

**Not that the new theory of heredity followed logically and necessarily from his agronomic techniques.

Together they announced a new theory of heredity that rejected the existence of genes and held that the basis of heredity did not lie in some special self-reproducing substance. On the contrary, the cell itself, in their view, developed into an organism, and there was no part of it not subject to evolutionary development. Heredity was based on the interaction between the organism and its environment, through the internalisation of external conditions. They thus recognised no distinction between genotype and phenotype.***

***The **genotype** refers to the complex genes hereditarily transmitted to the individual. The **phenotype** designates the totality of characteristics displayed by an individual and is the result of the interaction between heredity and environment.

The science of genetics was denounced as reactionary, bourgeois, idealist and formalist. It was held to be contrary to the Marxist philosophy of dialectical materialism. Its stress on the relative stability of the gene was supposedly a denial of dialectical development as well as an assault on materialism. Its emphasis on internality was thought to be a rejection of the interconnectedness of every aspect of nature. Its notion of the randomness and indirectness of mutation was held to undercut both the determinism of natural processes and man's ability to shape nature in a purposeful way.

The new biology, with its emphasis on the inheritance of acquired characteristics and the consequent alterability of organisms through directed environmental change, was well suited to the extreme voluntarism that accompanied the accelerated development of the drive to industrialise and collectivise. The idea that the same sort of willfulness could be applied to nature itself was appealing to the mentality of those who wished to stress that Soviet man could transform the world in whatever way he chose to do so. Lysenko's voluntarist approach to experimental results and to the transformation of agriculture was the counterpart of Stalin's voluntarist approach to social processes, undoubtedly a factor in Lysenko's managing to capture Stalin's imagination in this period.

However, other political leaders and scientific administrators were not so easily swayed. There was strong resistance within the Academy of Sciences and Bukharin let it be known that he sided with the geneticists - not that this went very well for them once Bukharin was condemned. But the geneticists fought their corner and had very influential support.

A climactic point in this new debate was reached at a special session of the Lenin Academy of the Agricultural Sciences held December 19 to 27, 1936, and devoted to a discussion of the two trends in Soviet biology, now designated as the Mendelist-Morganist trend and the Darwinist-Michurinist trend. The official goal set for the conference was to achieve a reconciliation of the two schools of thought, some kind of accommodation for genetics within the framework of Lysenko's agrobiology. The outcome was the opposite.

The open confrontation of the two trends resulted in drawing the lines more sharply than ever and in highlighting the irreconcilability of the two contrasting lines of approach. There were some compromisers present, such as B.M. Zavadovsky and N.P. Krenke, but the overall mood was a severely uncompromising one. The most intransigent group was that of Lysenko, Prezent, and their followers. The geneticists fought hard and unflinchingly for the future of their science, although it must be said that they were more than willing to concede the value of Lysenko's work in the sphere of agronomy. Vavilov, for example, was favourably disposed to Lysenko's ideas about the phasic development of plants and summer planting of potatoes. But nothing less than the total renunciation
of the science of genetics by the geneticists would placate the Lysenkoites.

Serebrovsky spoke bitterly against the Lysenkoite attacks on some of the greatest achievements of the 20th century and charged them with using revolutionary slogans towards reactionary ends. They were attempting to thrust Soviet science backward a half-century and this could only hinder the effort to establish scientific research on a new socialist basis. Dubinin posed the issues in similar terms.

The sharpest speech in the defence of genetics came from the American geneticist H.J. Muller, a foreign member of the USSR Academy of Sciences who had come to work in the Soviet Union out of commitment to the possibilities of science under socialism. Muller was also inclined to philosophical reflection on his science and had very definite views as to the place of genetics within the framework of a dialectical materialist philosophy of science. He turned the charge of idealism back against the Lysenkoites and accused them of being machists, hiding behind the screen of a falsely interpreted dialectical materialism.

In the period following the conference, the Lysenkoites carried on a campaign against the geneticists that became more and more vicious and more and more slanderous. Scientific and philosophical arguments increasingly gave way to political ones. The pursuit of genetics was spoken of as synonymous with adherence to the cause of reaction ...and this was identified with racism and fascism. Yakovlev, one of the highest administrators in Soviet agriculture, referred to genetics as the "handmaiden of Goebbels' department". Various geneticists and supporters of genetics were named and accused of sabotage, wrecking, espionage, terrorism, and Trotskyism. Prezent, in a 1937 article, singled out Agol, Uranovsky, and Bukharin as representing the "powers of darkness" opposing the creative direction being taken by Soviet biology. These bandits and Trotskyists had supposedly sold out, wholesale and retail, the interests of Soviet science.

The main target of the campaign was Vavilov, who was becoming ever more resolute and forthright in defending genetics and resisting the forces moving to destroy it. He was identified by the opposition as the main stumbling block standing in the way of complete victory for Lysenko’s views. Vavilov believed the situation was becoming intolerable and complained of Lysenko's low level of culture, his outmoded scientific views, but most of all about his intolerance and the reprisals that were taken against those who disagreed with him. Vavilov was defiant, despite the danger, and he declared in 1939:

We shall go the pyre, we shall burn, but we shall not retreat from our convictions. I tell you, in all frankness, that I believed and still believe and insist on what I think is right.... This is a fact, and to retreat from it simply because some occupying high posts desire it is impossible.

Vavilov was not being overdramatic. Already he had lost his position as president of the Lenin Academy of Agricultural Sciences, succeeded first by A.I. Muralov and then by G.K. Meister. In 1937, each of these in his turn was arrested and in 1938 Lysenko succeeded to the post. In 1938 Vavilov was rebuked by the presidium of the Academy of Sciences for isolating the Institute of Genetics from the trend stemming from Academician Lysenko's scientific work. Prior to this, a campaign against A.K. Koltsov, director of the Institute of Experimental Biology, had cleared the way for the election of Lysenko as academician.

In 1940, Vavilov was himself arrested, and Lysenko replaced him as director of the Institute of Genetics of the Academy of Sciences. In 1941, Vavilov stood trial and was found guilty of sabotage in agriculture, belonging to a rightist conspiracy, spying for England, and a string of other charges. Although he denied all accusations and the "evidence" consisted of false testimony, he was sentenced to death. After spending several months in a death cell, Vavilov's sentence was commuted, but he died in prison in 1943 of malnutrition.

*Vavilov was posthumously rehabilitated by the USSR Supreme Court in 1955, before the 20th Congress of the CPSU.
Vavilov was not the only one. The growing ascendancy of Lysenko coincided with the purges that reached into virtually every Soviet institution during 1936 to 1939. Already, before Vavilov's arrest, the losses among Soviet biologists had been staggering. In 1936, Israel Agol, Max Levin, and Solomon Levit, all communists working in the field of biological theory, were publicly denounced as "enemies of the people" and arrested. With regard to Agol and Levin, the charges involved vague references to "menshevising idealism" and association with a trotskyist conspiracy. As to Levit, the director of the Institute of Medical Genetics, his studies of human heredity had supposedly made him an abettor of nazi doctrines, or so it was declared at a meeting of the science division of the Moscow party organisation, presided over by Amost Kolman. Levit died in prison and his institute was closed. The other two were shot.

All three were posthumously rehabilitated, as were a number of other biologists and agricultural specialists who perished during this period.

They were followed by a host of others. Many were arrested. Of these some were shot, while others simply died in prison. Others were witch-hunted, lost their jobs, and were forced into other areas of work. Institutes were closed down. Journals ceased to appear. Books were removed from library shelves. Texts were revised. Names became unmentionable. The 7th international congress of genetics, which was scheduled to be held in Moscow in August 1937 was cancelled. When the congress did take place in Edinburgh in 1939, no Soviet scientists were present, not even Vavilov who had been elected its president.

Nevertheless, the opposition was still strong. The effects of the purge had been somewhat uneven. Ironically, in some cases, the most outspoken and defiant survived, while the more compromising elements perished. Serebrovsky, Dubinin, Koltsov, Zhebrak, M.M. Zavadovsky, and others continued to resist Lysenkoism. D.N. Prianishnikov had the audacity to nominate the imprisoned Vavilov for a Stalin prize. Many of their colleagues, however, gave way under the pressure, engaged in abasing self-criticism, and acknowledged the superior wisdom of Lysenko. The degree of demoralisation was overwhelming.

In October 1939, there was another conference called in another effort to achieve some sort of compromise. This time it was organised under the auspices of the journal Pod znamenem marksizma by the philosophers, who had been called upon by the presidium of the Academy of Sciences to abandon their neutrality in the struggle between the two trends in biology. Mitin attempted to drive a wedge between Lysenko and Prezent, praising the work of Lysenko, but criticising the "boundless conceit" of Prezent in trying to fasten his "scholasticism" and "bombast" onto Lysenko's work. Lysenko would have none of it, however much Mitin continued to try to persuade him to preserve his practical results from the tendency toward the scholastic imposition of philosophical categories on concrete material. Lysenko continued to object and brought forward quotes from Engels to prove that the classics of marxism were on his side. Mitin, however, undercut this line of argument by asserting that there were obsolete ideas even in the classics of marxism, "the holy of holies of our theory."

At the same time, Mitin was not defending the geneticists and he drew them into a rather strained analogy that presented views put forward in the biological debate as parallels to "menshevising idealism" in the philosophical debate, and to the theories of the "Trotsky-Bukharin-Pashukanis gang" and other such "wreckers" in the political debate. Yudin, for his part, called upon geneticists to clear up the "rubbish and slag" that had accumulated in their science.

Nevertheless, the philosophers held back at condemning the science of genetics and backing Lysenko's theories as the one and only dialectical materialist position in biology. They appealed to both sides to be less intransigent, asking the geneticists to concede the supreme importance of agrobiology, and the Lysenkoites to suspend their efforts to suppress genetics. In time Mitin and the rest abandoned all such reserve and came in solidly behind Lysenko.

So it went with Soviet biology. There remained two conflicting theories of heredity, each claiming
for itself both scientific validity and philosophical superiority. Lysenko continued to move from strength to strength, while his opponents were hounded, purged, jailed, and shot. Nevertheless, neither the party nor the philosophical leadership had decisively committed itself to Lysenko's theories or to a repudiation of the science of genetics. But it was early days yet.*

* The "Lysenko affair" still had a long way to go. Not until 1948 did Lysenkoism reach its peak. The decisive confrontation of that year resulted in official endorsement of Lysenko's views and corresponding repression of those of the geneticists. Within a few years, however, the struggle resumed again. It was an extremely protracted episode in Soviet history, with complex political, scientific and philosophical issues coming into play and requiring analysis. Quite a number of accounts of the controversy surrounding Lysenko are available.


http://www.shef.ac.uk/uni/academic/N-Q/psyc/staff/rmyoung/papers/getting.html

My own view of what is required in the way of an analysis of Lysenkoism is that it cannot be understood simply as a story of personal opportunism and political terror, nor as a cautionary tale against the dangers of bureaucratic interference in intellectual life or of ideological distortion of science. These are obviously elements of an analysis, but it is vital to see the emergence of Lysenkoism as no historical accident, as no imposition of alien elements (philosophy and politics) upon science.

It was a movement reflecting the temper of the times and groping with very real problems. It must be understood against the background of the tasks of political and cultural revolution, the drive to create a socialist intelligentsia, the push to transform every sphere of life and thought (including science and agriculture) in a new social order. Such tasks naturally involved struggling with such issues as the ideological character of science, hereditarism versus environmentalism, determinism versus voluntarism, the relationship of philosophy to biology, the relationship of biology to agronomy, and so on.

What went wrong was that the proper procedures for coming to terms with such complex issues were short-circuited by grasping for easy slogans and simplistic solutions and imposing them by administrative fiat. It was a tragedy parallel to other tragedies in Soviet life at this time, rooted in the same tensions opening in the yawning gap between the monumentally advanced tasks undertaken in Soviet political life and the persisting cultural underdevelopment of Soviet society … and this in conditions of hostile encirclement.

The sorts of conclusions to be drawn are: that there are no shortcuts in dealing with such intricate issues and that a certain cultural level is required to deal with them competently. The sorts of conclusions not to be drawn are: that science must be kept free from philosophy and from politics, that science is in essence non-ideological and that ideology is necessarily antithetical to science. Science is inextricably tied up with philosophy, politics and ideology.

References for this text (pages 217 to 228) can be found in the end of chapter notes pages 241 to 243.

[Marxism and Science main page](#) | [Marxists Internet Archive](#)
Marxism and the Philosophy of Science:
A Critical History

by Helena Sheehan

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Dedication & acknowledgements

This book attempts to give a historical account of the development of marxism as a philosophy of science as well as a philosophical account of the issues involved. It encompasses the 1st 100 years of the existence of marxism, beginning with the mid-1840s when the philosophical ideas of Marx and Engels began to emerge in mature form, and ending with the mid-1940s with the dissolution of the Comintern and the end of WW2.

It deals with both the mainstream of the marxist tradition in the development of dialectical materialism as a philosophy of science and with diverging currents advocating alternative philosophical positions. It shows the marxist tradition to be far more complex and differentiated than is usually imagined, characterised by sharp and lively controversies for contending paths of development at every step of the way.

Essentially this work is about the shifting nexus of science, philosophy and politics within marxism. It examines the multiplicity of factors coming into play, including the impact of new scientific discoveries, new philosophical trends and new political formations upon the overall process.

Among the most important philosophical issues arising are: the formation of world view vis-a-vis the process of scientific discovery; the relationship between dialectical materialism and communism; the notion of proletarian science; the concept of the dialectics of nature.

As the work is unique, insofar as there is no other history of marxist philosophy of science covering the whole period in question, it abounds in original research and original conclusions. Where there is a body of secondary literaturre in existence, with respect to specific authors or specific periods, it surveys this literature and takes a specific interpretive position. On a number of matters of ongoing controvery, such as the Marx-Engels relationship and the relationship of the Oparin-Haldane hypothesis on the origin of life to marxist philosophy, a definite position is argued.

The overall conclusion reached by the book is that this is a rich and significant history, rooted in the impulse to work out a philosophical world view grounded in the most advanced science of its day and integrally connected to the struggle to revolutionise its social matrix and to create a socialist social order.

An audacious enterprise, it generated not only impressive achievements, but also tragic disasters. It is a history with a dark side as well as a bright one. An effort is made to see both in proper perspective.

(From the dust jacket of the 1st edition)

Marxism and the Philosophy of Science won a Choice award for best academic books of 1985.

To buy this book online, go to:
Amazon.com: Marxism and the Philosophy of Science : A Critical History : The First Hundred Years

home page of  Helena Sheehan

Portrait of a Marxist as a young nun
Has the red flag fallen?
European socialism: a blind alley or a long and winding road?

Grand narratives then and now: can we still conceptualise history? 150 years after the Communist Manifesto
Songs of Irish Labour  CD
The Red Flag: the song, the man, the monument
Bread and Roses Productions

World Views

Some marxist websites (leading to lots of other marxist websites):

Marxism Page
Marx-Engels Archive

E-mail: helena.sheehan@dcu.ie
The conflict between the East and the West, although it involves different ideologies, has little to do with different concepts of physical reality. Ideologies differ because material and social interests differ; ‘physical reality’, on the other hand, is quite the same for all the combatants. Nevertheless, in both camps, the ideological struggle is carried into the natural sciences — in the East, in the form of a rearguard defence of dialectical materialism; in the West, in the assertion that dialectical materialism is “the real root of the conflict between East and West, because it is the basis of the fanatic belief of Marxists that the world is bound to fall to them spontaneously and inevitably”.[1]

Both sides insist, of course, that their scientific interpretations of the external world are free of all ideological encumbrances. While for the Eastern scientists and philosophers the whole of modern physics seems to verify dialectical materialism, for those of the West Marxism appears completely outdated because the idea of determinism has disappeared. The very term ‘materialism’ is rejected as belonging to the last century. During Marx’s lifetime, it is pointed out, “nothing was known of today’s relativistic and atomistic physics; matter was at that time what our senses conveyed it to be; physical measurement dealt with sensually perceivable properties of things.[2] which is no longer true.

Marx, of course, had only the natural science of his period to rely on; but the changes in science since then do not affect his theories. Marx did not coin the term dialectical materialism but used the word material to designate the basic and primary conditions of all human existence. Hegel’s dialectic merely formed the point of departure for Marx’s critique of capitalist society. It was important to Marx because of “the enormous historical sense upon which it was founded,” and because “it dissolves all conceptions of final, absolute truth, and of a final, absolute state of humanity corresponding to it.”[3]

The materialism which Marx encountered was not historical, and the dialectic then in vogue was not materialistic. By pitting Feuerbach against Hegel and Hegel against Feuerbach, Marx developed his own concept of social development, for which Friedrich Engels coined the term historical materialism. This materialistic conception of history did not stem from the “physical determinism derived from Newtonian mechanics”. [4] on the contrary, it developed, by way of dialectics, in direct opposition to the materialism based on Newtonian mechanics. It excluded the idea of human history being determined by over-riding ‘natural laws’, whether mechanical or dialectical. Although recognising the inter-relations between men, society and nature, it was, first of all, a theory of men and society.

Unfortunately, however, the persuasive power of historical or dialectical materialism — as it came to be known — was great enough to carry away even Engels, who spoke of its universal validity. While some tolerant critics found this merely amusing,[5] the less well-disposed used this over-
zealousness as an excuse to reject the whole of Marxism as just an oddity of German mysticism. But while the notion of the ‘universality’ of the dialectic process is not defensible, neither is it essential to Marxism, which loses none of its force by omitting it. Marx, at any rate, did not concern himself with the ‘dialectics of nature’. However, it is not the ideas of Marx but ‘Marxism’, as the ideology of the rising European labour movement and of the self-declared ‘socialist’ states of the Eastern power bloc, that nourishes Western anti-Marxism. And it is for this reason that the struggle between the ‘Marxist’ East and the anti-Marxist West, however real, tells us nothing about the validity or invalidity of Marxism for our time.

**Marxism as Ideology**

The pre-capitalist world was agitated by the question of the primacy of spirit or nature. “Those who asserted the primacy of spirit to nature comprised the camp of idealism. The others, who regarded nature as primary, belonged to the various schools of materialism. In opposing both the conditions and the religious ideologies of the feudal past, the revolutionary middle class was materialistic. It considered nature as objectively-given reality and man as determined by natural laws. The natural sciences were to explain his life and actions and, with the function of his brain, his sensations and consciousness. Freed from religious superstitions, science devoted itself to the discovery of natural laws, and Newtonian mechanics served as the basis for a growing conviction that all natural phenomena follow definite causal rules.

Radical middle class materialism lost its ideological urgency with the establishment of the bourgeoisie as the ruling class. The emancipation of natural science from theology could not be extended to the emancipation of society from religion. As Napoleon expressed it: “As far as I am concerned, religion is not the mystery of creation but the mystery of society. Religion connects the idea of equality with heaven and thus prevents the butchery of the rich by the poor. Society depends on the inequality of incomes, and the inequality of incomes, on the existence of religion.”

The co-existence of science and religion in the uneasy bourgeois world found ideological support in idealistic interpretations of the further results of scientific development.

The early materialists, or natural philosophers (Francis Bacon and Thomas Hobbes) were convinced that through sense experience and through intellectual activities derived therefrom, it would be possible to gain absolutely valid knowledge of the external world. This optimism vanished with John Locke, who saw this knowledge limited by the very intervention of ideas. He thought it valid only to the extent to which ideas were actually in conformity with things. Although sensations and ideas related to the external world, this world itself could not be really known. Immanuel Kant accepted the proposition that ultimates (the thing in itself) are not knowable and that empirical knowledge restricts itself to the subjective forms in which man becomes aware of the objective world. It was for this reason that he saw the need for a priori concepts which brought order into experience and made it intelligible. Concepts of time, space and causality were inventions of the human mind and, though not empirically verifiable, were nevertheless necessary to science, philosophy and effective human activity. In its essential structure, the world was, then, a product of the idea. And just as the materialist theory of knowledge became for many materialists the materialist theory of reality, so for many idealists the idealist theory of knowledge became an idealist theory of reality.

In an attempt to carry the materialist representation of the objective world into the process of knowledge itself, Ernst Mach opposed both the new idealism and the old materialism. He insisted “that we cannot make up properties of nature with the help of self-evident suppositions, but that these suppositions must be taken from experience”. But, since all knowledge derives from sensations and cannot go beyond sensations, it cannot make statements about objective reality; it can merely fill out the gaps in experience by the ideas that experience suggests. Although he opposed the Kantian point of view, he also rejected mechanical materialism and regarded its objective world of matter, space, time and causality as artificial conceptions. Mach’s critical
empiricism supported, although unintentionally, a rising idealistic trend in the philosophy of science.

Marxist ‘revisionism’, i.e. the successful development of labour organisations within the confines of capitalism and the hope, connected therewith, of a purely evolutionary transition from capitalism to socialism, led to the loss of an earlier militant atheism and to an ambiguous acceptance of the rising idealist trend in the form of neo-Kantianism. Radical socialists began to defend the old materialism of the revolutionary bourgeoisie against the new idealism of the established capitalist class and its adherents in the labour movement. For Russian socialists this seemed of particular importance since the Russian revolutionary movement, still on the verge of the bourgeois revolution, waged its ideological struggles to a large extent with the arguments of the Western revolutionary bourgeoisie. The intelligentsia, largely from the middle class, formed the spearhead of the movement and was quite naturally inclined to adopt Western middle class materialism for their own purposes, that is, for the task of opposing the religious ideology that supported Czarist feudalism.

Because, for Ernst Mach, science had its origin in the needs of life, his ideas had a certain appeal to socialists. Some Russian revolutionaries, Bogdanov in particular, tried to combine them with Marxism. They gained some influence in Russia’s Socialist Party and Lenin set out to destroy this influence with his book, *Materialism and Empiriocriticism*. The subjective element in Mach’s theory of knowledge became, in Lenin’s mind, an idealist aberration and a deliberate attempt to revive religious obscurantism. It was Mach’s insistence upon the derived, abstract character of the concept of matter which disturbed Lenin particularly, because for him, as for the early materialists, knowledge was only what reflects objective truth; truth, that is, about matter. He thought that reducing objective reality to matter was necessary for the unconditional recognition of nature’s material existence outside the mind.

The independent existence of the external world was not denied by Mach. He merely pointed out that our knowledge in this respect is limited because it is limited to sense experience. But Lenin found it “unconditionally true that to every scientific theory there corresponds an objective truth, something absolutely so in nature”. [9] For him dialectical materialism had already discovered what nature is and does, if not as yet completely, at any rate approximately. “From the standpoint of modern materialism, or Marxism,” he wrote, “the relative limits of our approximation to the cognition of the objective absolute truth are historically conditioned; but the existence of this truth is unconditioned, as well as the fact that we are continually approaching it.”[10] With the discovery of the substance and motion of the universe, all that was left to do was to proceed in every separate field of knowledge in accordance with the principles established for nature as a whole. One could then not fail to have scientific practice conform with objective reality, just as the latter was bound to show up in every true scientific endeavour. The difficulty with this is, of course, that it is impossible to apply the criterion of practice to a theory of the universe, not to speak of the fact that nobody knows what nature as a whole is.

It was in this way that Lenin extended historical materialism into dialectical materialism. Nature has had a history and its dialectical pattern of development has been progressive in the sense that it has developed from the inorganic through the organic mind and consciousness. “Matter is not a product of mind,” Lenin wrote, “but mind itself is only the highest product of matter.”[11] The world was an “eternally moving and developing material mass which reflects a progressive human consciousness”. [12] Human history is a product of universal history. In a certain sense, this is true and follows from the admission of the existence of the external world independent of human existence. And it is clear that consciousness presupposes the existence of the brain.

But it is also true, as Marx pointed out, “that the question whether objective truth can be attributed to human thinking is not a question of theory but is a practical question. In practice men must prove the truth, i.e. the reality and power, the ‘this-sidedness’ of their thinking. The dispute over the reality or non-reality of thinking which is isolated from practice is a purely scholastic question.”[13]
The atomic theories of the ancient Greeks, for instance, were based not on experimental facts but were part of a speculative cosmic philosophy and were opposed and defeated by other philosophical schools on purely philosophical grounds. This can no longer be repeated, for today’s atomic theory is based on experiment and mathematical treatment, on a scientific practice in brief, able to verify the theory’s validity. Not mere speculation but the work of chemists and physicists led from the atomic to the nuclear theory, to the new physics and the new philosophy associated with it. All real knowledge of the external world is the product of men’s theoretical and practical activity in the actual world. But this knowledge produced by men can never be more than knowledge produced by men; it is not absolute truth. It is only truth about that part of the universe currently accessible to men, on which they can work and verify their theories. And as their knowledge accumulates with historical development, it leads to the continuous modification of knowledge by way of additional knowledge and sometimes to the discarding of theories made superfluous by theories referring to new discoveries.

The decline of the radical Western labour movement and the success of Russian bolshevism brought with it an almost complete identification of a specific Leninist version of Marxism with Marxism proper. Because the Russian Revolution was simultaneously a ‘bourgeois’ and a ‘proletarian’ revolution — in the sense that the preconditions for socialism were non-existent while *laissez faire* capitalism was no longer possible — it led to a form of state-capitalism which could be designated as ‘socialism’ only because it was something other than private-property capitalism. But the functions assigned to private enterprise and competition were now the functions of the bolshevik state. By appropriating part of the social product and allocating productive resources for the construction of a larger productive apparatus and a higher productivity, the bolshevik rulers turned into controllers of labour and capital.

While the capitalist’s ‘peace of mind’ and the necessary acquiescence of the workers require some form of general agreement on the indispensability of capital and private initiative, the new Russian situation needed a different ideology that could make the interests of the controllers and the controlled appear identical. Marxism could somehow satisfy this need because it was formulated during capitalism’s *laissez faire* stage. For there were no longer in Russia any capitalists in the traditional sense; and as to the government, it characterised itself as the executive of the ruling working class.

But since only the miserable are inclined to believe in an equal sharing of a miserable situation, the bolshevik ‘elite’ soon found that income differentiations, by serving as incentives for greater individual effort, could turn into a blessing for all. In order to improve the life of all in the long run, it was necessary to improve that of some immediately. Thus a new class came into being based on control of the state apparatus and nationalised means of production. To hasten productive developments, both the ‘positive’ incentives of power and income, as well as the ‘negative’ incentives of forced labour and terrorism were repeatedly advanced. Yet, the more the interests of the controllers and the controlled diverged, the more insistently did ideology proclaim their identity.

Under relatively stable social conditions ideological control may suffice to secure the social status quo. Under such conditions, designated as a ‘free’ or ‘democratic’ society, a struggle for ideas accompanies the social conflicts, and its class structure is simultaneously denied and admitted. Both the existence and non-existence of class relations, for instance, are incorporated in such concepts as ‘social mobility’ and ‘equal opportunities’. Socialism would eliminate these ambiguities, for if there are no classes there is no way of moving from one class to another, and if there are no privileges there are no equal opportunities to partake of. Russian society, while supporting a privileged minority, necessarily adheres to the concept of ‘equal opportunities’, but it cannot admit the existence of class relations without destroying its socialist label.

Even if, out of fear of utopianism, Marxian socialism never became explicit, one thing was clear nevertheless: socialism implies a classless, non-exploitative society, and not merely a modified class relationship in a modified capitalism. In Russia, ideology only can claim the absence of class
relations. Yet, the ruled cannot help being aware of existing conditions and of their unrelatedness to the state-prescribed ideology. This ideology cannot serve as a substitute for, but is an aspect of, direct physical control — an instrument of police power. The enforced absence of social conflicts finds not support, but merely expression, in the apparent unanimity of ideas.

It was in the name of Marxism and socialism that the bolsheviks came into power, and in their name they destroyed all their enemies. Even their internal struggles for positions and influence within the controlling hierarchy must be expressed in Marxian terms — either as adherence to, or as an alleged deviation from, a once-established ‘orthodoxy’. The total unrelatedness of Marxian socialism to Russian conditions makes impossible any questioning or serious discussion of Marxian theory. Lenin’s dogmatised ‘Marxism’ must be accepted as an article of faith. only in this way can it be fitted into Russian conditions. And it is not only Lenin’s use of middle class materialism in defence of ‘Marxism’ which indicates the half-bourgeois, half-proletarian character of bolshevism and of the Russian Revolution itself. There is also the bolshevik state-capitalist concept of ‘socialism’, the authoritarian attitude toward organisation and spontaneity, the outdated and unrealisable principle of national self-determination and, finally, Lenin’s conviction that only the middle class intelligentsia is able to develop a revolutionary consciousness and is thus destined to lead the masses. The combination of bourgeois materialism and revolutionary Marxism which characterised early bolshevik philosophy reappears with victorious bolshevism as a combination of neo-capitalist practice and socialist ideology.[14]

Science and Society

“In social production,” Marx wrote, summing up his materialism, “men enter into definite relations that are indispensable and independent of their will; these relations of production correspond to a definite stage of development of their material powers of production. The sum total of these relations of production constitutes the economic structure of society — the real foundation, on which rise legal and political superstructures and to which correspond definite forms of social consciousness. The mode of production in material life determines the general character of the social, political and spiritual processes of life. It is not the consciousness of men that determines their existence, but, on the contrary, their social existence determines their consciousness.”[15]

Marx did not concern himself with the dialectic or any other absolute law of nature because for him “nature fixed in isolation from men — is nothing for men”. He dealt with society as an “aggregate of the relations in which the producers live with regard to nature and to themselves”. Although nature exists independently of men, it exists actually for men only in so far as it can be sensed and comprehended. The labouring process in its various forms, including scientific labour, is the interaction and metabolism between men and nature; it dominates, exploits and alters nature, including the nature of man and society. ‘Laws of nature’ relate not to ‘ultimate reality’ but are descriptions of the behaviour and regularities of nature as perceived by men. Perceptions change with the change of knowledge and with social development which affects the state of knowledge. Concepts of physical reality relate then not only to nature and men but also indirectly to the structure of society and to social change and are therefore historical. Although specific social relationships, bound to specific forms of social production, may find ideological reflection in science and affect its activities in some measure; science, like the production process itself, is the result of all previous social development and in this respect is independent of any particular social structure. Concepts of physical reality may be shared by structurally different societies. And just as different technologies may evolve within a particular social structure as, for instance, the current so-called Second Industrial Revolution, so one concept of physical reality may be replaced by another without affecting existing social relationships. Yet, these new concepts are still historical in comparison with earlier concepts of physical reality associated with previous and different modes of production and previous and different social relationships.

Science in the modern sense developed simultaneously with modern industry and capitalism. The
rapidity of scientific development parallels the relentless revolutionising of the production process by way of competitive capital accumulation. There is an obvious connection between science, its technological application and the prevailing social relationships. Although modern science is not only quantitatively but also qualitatively different from the rudimentary science of the past, it is a continuation of it nonetheless. Likewise, the science and technology of the hypothetical socialist future — no matter how altered — can only be based on all previous scientific and social development. There is no ‘bourgeois science’ to be replaced by ‘proletarian science’. What a Marxist critique of science is directed against is the class-determined ideological interpretation and class-determined practical utilisation of science wherever and whenever it violates the needs and well-being of humanity.

Although science strives toward some hypothetical ideal objectivity, the application of science is guided by other considerations. Like the utilisation of other productive and human resources, it is subordinated to the requirements of class relations which turn the social production process into capital formation. The utilisation of science for prevailing profit and power principles may not affect internal scientific objectivity, but it affects the direction of scientific exploration. Because there is no ‘end’ to science and because its fields of exploration are unlimited, science can choose to concentrate upon one or another. The emphasis upon a specific field and a particular direction depends upon the needs, structure and superstructure of a particular society. There was, in the sixteenth and seventeenth centuries, an obvious connection between the concentration on astronomy and the development of world trade. There is an obvious connection between the present emphasis on atomic physics and the current imperialist military struggles.

In Marxist values, man is the measure of all things and science should be science for men. As socialism implies the further growth of the social forces of production, it also implies that of science. It intends to add to the principle of scientific objectivity that of social responsibility. And just as it rejects fetishistic capital accumulation, so it rejects ‘science for the sake of science’. This fetishistic attitude towards science, supposedly based on an innate human need to search for ultimate reality, is actually only another expression of the lack of sociality in class society and the fierce competition among scientists themselves. The irresponsible, irrational and self-defeating disregard for humanity on the part of many scientists today, who defend their work in the name of science even though it has often no other but destructive purposes, is possible only in a society that is able to subordinate science to the specific needs of a ruling class. The humanisation of science presupposes, however, the humanisation of society. Science and its development is thus a social problem.

Materialism and Determinism

Marxism, not being a theory of physical materialism and not bound to Newtonian determinism, is not affected by the new physics and microphysics. To be sure, Marx had no way of rejecting and no desire to reject the physics of the nineteenth century. What distinguished his historical materialism from middle class materialism was his rejection of the latter’s direct confrontation of individual man and external reality and its inability to see society and social labour as an indivisible aspect of the whole of reality. What united Marxism with middle class materialism was the conviction that there is an external world independent of men and that science contributes to the knowledge of this objective reality.

While Marxists accept the positivist emphasis on experience, they reject the notion that sensations are the sole source of experience — a notion which led some people into the self-contradictory sterility of solipsism and others to idealism and the indirect justification of religious beliefs. Although sense perceptions are individuals’ perceptions, men extended the range and amplified the powers of their senses in quality as well as quantity. Moreover the “knowledge of an orderly external world on which we can act rationally is derived almost entirely from society. The scraps disclosed in sense perceptions by themselves would make no pattern but fit into the pattern whose
outlines society has taught us. Indeed what we perceive with our sense organs is conditioned very largely by our education — by what our elders and fellows have taught us to notice.[18]

The concept of matter now implies something different from what it did a hundred years ago. While for Lenin, and middle class materialism before him, matter, composed of atoms, was the very stuff of nature, and for Mach atoms were a mental artifice not susceptible to sense experience, matter is now regarded as something ‘in-between’ because matter as given by our senses appears as a secondary phenomenon, created by the interaction of our sense organs with processes whose nature can be discovered only indirectly, through theoretical interpretations of experimentally observed relationships; in other words, through a mental effort.” [19] Matter was once conceived as consisting of indivisible atoms. This concept lost its validity by newly discovered properties of matter such as radio-activity. It was found that “material particles are capable of disappearing while giving rise to radiation, whilst radiation is capable of condensing into matter and of creating particles”. [20] Einstein formulated the transformation of mass into energy and now the term, matter, when it is used, includes all the physical phenomena of which men are aware. Experimental methods were devised which recorded the effects of atoms and of the elemental particles of which they are composed. These elemental particles may be considered the ultimate units of matter — “precisely those units into which matter decomposes under the impact of external forces. This state of affairs can be summed up thus: all elemental particles are made of the same stuff — namely, energy ...

Matter exists because energy assumes the form of the elemental particles. [21]

These discoveries do not deny the objective existence of physical reality, nor its manifestation in things considered to constitute matter. Whatever science may reveal as properties of nature, and whether or not matter is considered ‘real’ or ‘unreal’, as a ‘primary’ or as ‘secondary’ phenomena, it exists in its own right and without it no immaterialist would be there to deny its existence. The material world is the world of men, quite independent of the fact — scientifically or philosophically speaking — that the old concept of matter is insufficient to account for physical reality.

The equivalence of mass and energy, of light and matter, extended the wave-corpuscle duality — at first discovered for light — to all matter. Like light, material particles can be pictured as either corpuscles or waves, and both pictures are necessary to explain their properties. According to Max Planck’s quantum theory radiation is not continuous but, like matter, can be dealt with only in individual units. Emission and absorption of these units involves the principle of probability. The application of quantum mechanics to the problems of atomic structure by Niels Bohr and Werner Heisenberg led to the principle of uncertainty, of indeterminism, and to the concept of complementarity. According to the latter the description of micro-objects, such as electrons, requires both wave and corpuscle models; although mutually exclusive, they also complement one another. The uncertainty principle relates to the impossibility of ascertaining with accuracy both the position and the momentum of a particle simultaneously.

Because in their totality the elementary processes constitute physical reality, the indeterminist, statistical, probabilistic character of quantum physics led to a denial of causality. Not all scientists, however, are willing to recognise acausality as a fundamental aspect of nature. For Einstein, quantum theory in all its implications seemed only a temporary makeshift — an expression of our ignorance. Max Planck held that the quantum hypothesis will eventually find its exact expression in certain equations which will be a more exact formula of the law of causality. And Heisenberg speculates whether acausality is only a consequence of the separation of observer and observed and is not applicable to the universe as a whole.

However this may be, the problem can only be resolved, if at all, by further scientific work. While some scientists hold that behind the statistical laws of quantum physics there are hidden, but discernable, parameters obeying the laws of classical physics, others think that causality in macroscopic phenomena is itself based on probability laws. While for some, causality once ruled absolutely, now chance rules absolutely for others. Marxism, which does not think in absolutes, accepts the state of physics for what it is, convinced that like any other state previously it, too, is
transitory and is not the final end of physical knowledge.

Newtonian mechanics worked well on the macroscopic and human scale of phenomena. The knowledge gained about objective reality through our sense organs and scientific instruments did not perceptibly affect external reality itself. In microphysics, however, the interaction between the observed and the observer affects the observed phenomenon. Sense impressions and instruments imply the transfer of energy (photons) which forms an integral part of the behaviour of the atomic objects under observation. This inescapable situation, deplored by some as the definite borderline to all understanding of objective reality, induced others to state “that science stands between man and nature”, and though events in the world of nature do not depend on our observations of them, nevertheless, “in science we are not dealing with nature itself but with the science of nature — that is, with nature which has been thought through and described by man”. [22]

While this aspect of quantum physics is used, more often than not, as an argument against philosophical materialism and as evidence in favour of idealism, in a way, and differently expressed, it rather suits Marxism quite well. What stands between men and nature also connects men and nature. Marxism, for which knowledge of objective reality implies the indivisible inter-relationship between man, society and nature, does not bother with an ‘objective reality’ apart from that recognisable by men. If there should be no way towards ‘absolute’ objectivity, that degree of objectivity attainable is the objective reality for men. The recognition that nature and the nature revealed through science may not be the same merely compels us to the largest possible degree of objectivity, quite apart from the question as to whether or not it will lead to an understanding of ‘ultimate reality’.

Microphysics is one of many human endeavours and though it led to new concepts of physical reality, it did not alter the human situation in the macroscopic world. The duality “between statistical and dynamic laws is ultimately associated with the duality between macrocosm and microcosm, and this we must regard as a fact substantiated by experiment. Whether satisfactory or not, facts cannot be created by theories, and there is no alternative but to concede their appointed places to dynamical as well as to statistical laws in the whole system of physical theories.” [23]

Space, time, causality, derived from experience, remain dependable guides to most human activities, quite independently of the over-riding or under-lying relativistic and atomistic theories of reality. It is quite certain that classical mechanics will “remain the instrument best fitted to solve certain questions, questions which for us are of the highest importance, since they relate to our scale of magnitude”. [24]

Nothing is altered in this situation if the deterministic interpretation of classical mechanics is also regarded as a fallacy. [25] For causality and determinism do not refer to nature in its totality but to our interrelationship with nature through which we discover rules and regularities that allow us to expect — and thus to predict — natural events with a degree of probability close to certainty. Although the early ideal of absolutely certain knowledge of the external world vanished in the very quest for scientific objectivity, ‘natural laws’ which allow for predictability retain their ‘absolute’ validity on the human scale of experience. And while the understanding of atomic processes implies probability and statistics, the utilisation of this knowledge leads to predictable activities as if based on cause-and-effect relationships. Likewise, “the notions of classical physics provide an a priori foundation for the investigations of quantum physics, since we can carry out experiments in the atomic field only with the aid of concepts from classical physics.”[26]

Because indeterminism rules in quantum physics, and determination is out of the question “even in the simplest classical science, that of mechanics”, Max Born finds it “simply fantastic to apply the idea of determinism to historical events”. [27] However, historical materialism, in so far as it claims predictive powers, does not claim that these powers are derived from, or are analogous to, natural processes but that they are based on ‘social laws’ of development fortified by the evidence of history. To reject ‘social determinism’ it is necessary to demonstrate its impossibility in society and history, not by analogy with physical processes. By doing the latter, Born does exactly — only the
other way around — what pseudo-Marxists were doing when they read ‘social laws’ of development into nature. If one analogy is bad, so is the other.

Society does not develop and function by chance but through human responses to definite necessities. Man must eat in order to live, and if he must work in order to eat, the work itself leads to a regulated behaviour on his own part and in connection with his obeying of, and his struggle against, natural phenomena and their regularities. When men work in groups and societies, new necessities and new regulations arise out of the social labour process. With the increase of productivity there develops social class relations and social regulations based on them. With the further growth of the productive powers of society the determination of human behaviour by external necessity diminishes while the determination by social arrangements increases. Determination is largely a social product; it is the social development itself which leads — with the recognition of the material and social requirements of production and reproduction — to predictability.

Because of the socially-produced character of social determination, Marx is neither a determinist nor an indeterminist in the usual sense of these terms. “In his opinion history is the product of human action, even while men are the products of history. Historical conditions determine the way man makes subsequent history, but these historical conditions are themselves the result of human actions ... The basic point of departure is never history, but man, his situation, and his responses.”[28]

In known history stages of human and social existence are recognisable through changing tools, forms of production, and social relationships that alter the productivity of labour. Where social production stagnates, society stagnates; where the productivity of labour develops slowly, social change is also tardy. But all previous development is the result of progress made in the sphere of production and it is only reasonable to expect that the future will also depend on it.

This indicates little with regard to the actual transformation from capitalism to socialism anticipated by Marx. It merely predicts that socialism is the next step in the development of the social forces of production, which includes science and social consciousness. Every class structure, according to Marx, both fosters and retards the general development of social production. It fosters it in contrast to previously-existing social relations of production; it retards it by attempting to make existing social relations permanent. Definite social class relations are bound to definite levels of the expanding social forces of production — all the actual over-lapping of old and new forms of social relations and modes of production notwithstanding. In our time, it is the capital-labour relationship, the basis of all social antagonisms, which fetters further social development. But such development requires the abolition of social antagonisms. And since only those able to base their expectations on a classless society are likely to strive towards its realisation, Marx saw in the working class and its needs a force of human emancipation.

Although Marx was convinced of capitalism’s inevitable end, he did not commit himself as to the time of its departure. This depended on the actual class struggle and was certain only on the assumption of a continuation of the previous course of social development. Future events can only be based on present knowledge and predictions are possible only on the assumption that the known pattern of past development will also hold for the future. It may not; yet, all knowledge justifies some expectations and allows for actions which themselves will decide whether the expectations were justified or not. When Marx spoke of the end of capitalism, he also thought of the elements of a new society already present and unfolding in the ‘womb of the old’. Capitalism had no future because its transformation was already an observable phenomenon. As it developed, it enlarged all its contradictions so that its expansion was at the same time its decay when regarded from a revolutionary instead of from a conservative point of view.
The Ideological War

While there is no connection between Marxism and physical determinism or indeterminism, there is also no real connection between the cold war and the different concepts of physical reality in the East and the West. Indeed, what possible connection could there be between the indeterminacy of nuclear physics and all the social problems that beset the world and give rise to its political movements? These social struggles were disturbing the world before the rise of the new physics and they cannot be abated by either science or philosophy. Political relations between East and West will not improve simply because physicists abstain from ideological interpretations of their work. This work, and its practical application, is the same in the East and the West. Where there is disagreement, it does not matter, i.e. in speculations as to what the physical knowledge of the future may reveal. Some Eastern scientists do not bother to embroider their work with philosophical interpretations; others try to fit it into the scheme of dialectical materialism so as not to violate the state-prescribed ideology in which they may also actually believe, just as Western scientists accept almost generally the ruling ideologies of their own society.

At any rate, reality is always stronger than ideology, as is demonstrated by the recurrent need to incorporate the new findings of science and the advancements of technology into the prevailing ideologies. There was a time when Russian dialectical materialists denounced Einstein’s relativity theory as bourgeois obscurantism, only, and rather quickly, to come to celebrate it as still another manifestation of dialectical materialism. Space-time, wave-mechanics, the structure of matter, in short, the whole of modern physics has been turned into so many revelations of the dialectics of nature and of its material substance. The principle of ‘complementarity’, i.e. the abandonment of a conceptually unitary picture of atomic phenomena, has been interpreted as yet another example of dialectical development by way of contradiction and reconciliation, that is, as a struggle between thesis and anti-thesis, bringing forth the synthesis.

As yet, however, the ‘synthesis’ is only philosophically anticipated by dialectical materialists to satisfy the Leninist criterion of absolute objective truth. Some Eastern physicists (not all) simply claim that the phenomena observed in microphysics with regard to both wave and particle are completely objective, whereas for some Western scientists (not all) they are in part subjective, because of the disturbing and altering interplay between observer and observed, and because wave has the character of a probability wave and is not regarded as an objective entity. Of course, the Russian physicists admit that the sheer objectivity of micro-objects is only partly recognisable but they believe that, in principle, it will be possible to establish their full objectivity by finding ways and means to discount the influence of the observer and his instruments upon the observed micro-objects. The application of atomic energy appears to them as proof of the objective character of atomic phenomena.

For Western physicists, all that matters presently is quantum theory in its present state and the problems to which it gives rise. This, of course, is also true for Russian scientists. And it can at once be admitted that their search for absolute objectivity, whether realisable or not, seems a better working-hypothesis than the subjectivistic resignation to an assumed absolute limit to the understanding of objective reality on the part of some Western physicists. However, atomic energy has been applied on both sides of the ‘barricades’; the pragmatic truth of atomic theory has been revealed quite aside from dialectical materialism and bourgeois idealism.

Because Lenin insisted on the objectivity and universal validity of causality and because Leninism is the ruling ideology, it cannot very well be denied by Russian physicists. There is also no real need to do so, for according to dialectical materialism causality does not exclude but implies chance. The indeterminacy in quantum physics, though recognised, is explained as due to experimental techniques and not to a fundamental law of nature. The differences between the Eastern and Western physicists may then be summed up as differences relating not to their work but to additional expectations on the part of Eastern physicists that their work will come to verify the assumptions of dialectical materialism.
These assumptions, however, relate not to the victory of socialism over capitalism, but merely to the re-establishment of causality for the whole of nature and to the re-acceptance of the concept of matter, in its present sense, as the sole basis of all existing phenomena including the human mind. Of course, in a certain sense, such expectations may be regarded as an expression of a general optimism associated with the rise, success and expected triumph of bolshevism and its ideological concomitant, Leninism. Still, it is difficult to see how dialectical materialism in physics could determine the political decisions of people one way or another or could be regarded an instrument of class struggle.

Ideologies are weapons, but in the age of the atom bomb they are no longer decisive or even very important weapons. As little as the Western nations trust in the ‘rationality’ and the ‘naturalness’ of their socioeconomic relations, just as little do the Eastern ‘Marxists’ put their trust in the dialectical course of history — not to speak of that in nature — as the means to final victory. Both sides rely, first of all, on their material might. It can only be to the good, of course, when material might finds ideological support, for which reason successful ideologists in both camps find themselves in comfortable income brackets. But their professional rating of the meaning and power of ideologies is only an over-rating of their own importance.

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6 F. Engels, Ludwig Feuerbach, p. 31.
7 Alphonse Aulard, Histoire Politique de la Révolution Française; Origines et Développement de la Démocratie et de la République (1789-1804), Paris, 1901, p.734.
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11 Ibid., p.63.
12 Ibid., p.109.
13 Marx’s Theses on Feuerbach in F. Engels, Ludwig Feuerbach, p.73.
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15 Critique of Political Economy, Chicago, 1904, p.11.
16 Economic and Philosophical Manuscripts of 1844, Moscow, p.169.
19 M. Born, The Concept of Reality in Physics, p.319.
22 W. Heisenberg, *From Plato to Planck*, p.112.
26 W. Heisenberg, *From Plato to Max Planck*, p.112.
27 *The Concept of Reality in Physics*, p.320.
1. What is the present-day science?

What is, and how should we recognise, the present-day science? We know both ancient Greek science and modern science after the Renaissance, as being contrasted to the present-day science. There are opinions such that Greek science should not be taken as a science. Nevertheless, I think it is also the science and bears a great significance even in the present age. Namely, various thoughts developed in Greek science show their profound effects in the present-day science. It is not too much to say that all sciences have their common origin in Greece. For example, the fundamental thinking on atomic research, to which I have been devoting myself, is well-known to be stemmed from Greek thinkers. In fact, the modern and the present-day sciences have been effected decisively from the atomism developed in ancient Greek schools by Democritus, Epicurus and others, who proposed atom theories in which they conceived, beyond human sensual abilities, microscopic particles-atoms-as the constituents of the whole universe. In all events, Greek science is a science which played a great role in our human history. The history then greeted the Renaissance after the Dark Ages of medieval centuries. A new science which was created in the Renaissance, i.e., the modern science, possessed a new character different from Greek science as was symbolised by the words “knowledge is the power of mankind” of Francis Bacon, and contributed greatly to the advancement of humanity. In today’s science there remain still many characteristic phases inherited from the modern science; many people are, therefore, looking to the character of today’s science as merely a continuous succession of the modern science. I think, however, that the present-day science is not, and should not be, the Greek science nor the modern science; it has and should have a significance as a new phase of science. Science is now confronting a grave crisis from both internal and external causes; the reason for it is that today’s science has not yet cast off the traditional skin of the modern science. The modern science turns, nowadays, to
strike mankind with monstrous terror contrary to man’s expectations that it would bring them the greatest felicity. What was the outcome of the birth of Greek science and the flourish of modern science in Europe? It was nothing but events of Auschwitz and Hiroshima, and furthermore the tragic Vietnam War of our days. Such a result is a destiny coming from the character of the modern science. The present-day science must proceed far beyond the modern science in order never to repeat these bitter experiences. ‘In reality, however, the present-day science has in it a latent power capable of overcoming the limit of the modern science. Although it looks that the present-day science which we, the men of the twentieth century, are endeavouring to develop for the future is a continuance of the modern science advanced after the Renaissance, many of the indications imply that it is not the case. Therefore, we ought to bring up such a new power in order not to let the results of the present-day science be the tragedy of Auschwitz, Hiroshima and Vietnam as was the case of Greek and modern science. The problem of clarifying the character of present-day science is closely connected with that of disclosing the philosophical and methodological implications inherent in the present-day science. Hence, I will begin our discussions with this point.

2. Marx, the source of the method of present-day science

In the twentieth century, there have been rapidly developed new sciences worthy of being known today as the present-day science in connection with the advancement of atomic physics. As a result, the present-day science has displayed its new view of nature different from that of the modern science, and has developed a new methodology of its own. However, in terms of the history of thoughts, the present-day science, or more precisely the thought and method of today’s science, stemmed not in our century but from the thought and method established by Marx early in the nineteenth century. Today, it is often said that social sciences are rather undeveloped compared with natural sciences. In fact, natural sciences in our days have produced such terrible weapons as A- and H-bombs, bacteria weapons, chemical gases and so on, thereby throwing mankind into serious crises. They claimed that the cause of human crises lies in the ill-balanced development between natural and social sciences. For example, the Science Council of Japan recently began organising discussions about desirable measures for the well-balanced advancement of both natural and social sciences. It is well known that one of the characteristic aspects of today’s natural sciences lies in the use of huge experimental instrumentations which need an enormous sum as well as the large scale collaboration of researching staffs, thus afterwards being called big science. Moreover, especially since we came into the twentieth century, it has appeared as an international trend of governmental policies, which have been giving too much importance to military researches, putting money only in natural sciences and, as a result, oppressing the study of social sciences on the other. Can we, however, say that the crises of mankind come from such an ill-balanced development between natural and social sciences, in accordance with the popular idea? I think this is not the case. Rather, the present-day science in a true sense was first established as a social science, already in the middle of the nineteenth century. It was Capital by Marx. This is indeed a science worthy of being called the present-day science. Behind Marx’s Capital there lies the dialectic materialism or its view of human history, and Marx discovered a highly lawful structure of human society by commanding profound logic of dialectics. In the twentieth century, the invaluable significance of Capital has been recognised more and more. Namely, the socialistic revolution succeeded first in Russia followed by the revolutions of China and other nations after World War II. Thus, a number of socialistic-republics have been established and Marx’s laws are being applied to their own lives. I know a famous scholar of economics who said that he made a better choice of non-conversion by witnessing recent dollar-crises, although many economists have come to conceive that Marxism turned to be out-dated in confronting a post-War prosperity of capitalistic regime of the United States. At any rate, it is hardly deniable that in giving real perspective for the future, what have really been the motive forces of revolutionising human history, there are books such as Marx’s, Capital, Lenin’s On Imperialism and Mao’s On Practice and On Contradictions.
3. The law of the atomic world-quantum mechanics

Turning our eyes to natural sciences, we see that Newtonian mechanics has the greatest significance in the modern development of science after the Renaissance. It was proved that Newtonian mechanics reflects the law of nature so profoundly that it has a great predictive power and governs the motions of arbitrary bodies in the world. As a result, the scientists in the nineteenth century were inclined to give an excessive value to Newtonian mechanics making their views of nature and the world narrow ones. At any rate, however, it had the greatest meaning in the modern science, and was one of those most highly developed sciences. Although the significance of Newtonian mechanics has not changed at all even today, a very important fact was disclosed in the beginning the twentieth century; that is, it does not govern all over the world, but have only a limited sphere of its applicability. This fact was first revealed by Einstein in the beginning of this century, when he discovered the theory of relativity, yet it was recognised more deeply when we stepped into the atomic world; it was realised that the atomic world was not governed by Newtonian mechanics. The law of motion of matter in the atomic world was the quantum mechanics discovered by de Broglie, Schrödinger, Heisenberg and others.

4. All laws have their own limits of applicability

What was clarified by the present-day science that has been developed on a foundation of atomic physics? In the first place, it is that, however great the power of prophecy an advanced law have, it has a limit of applicability. It shows great powers only within the scope of applicability, but if one goes beyond this limit, it loses all its power at once. The motion of an electron in the atom is completely different from the motion of bodies we can see with our eyes. For instance, in our world a man is not able to enter a room through two entrances simultaneously, yet an electron comes in from two slits at the same time. The fact that the motion of an electron is far beyond our conception means that there exists for the electron another, entirely different law from that for visible bodies. To speak more physically, an electron possesses both particle-like and wave-like natures. The modern technological innovation owes very much to quantum mechanics which governs the atomic world, just like Newtonian mechanics was the foundation of the mechanical civilisation in the nineteenth century. For example, without quantum mechanics one could never develop electronics using the semi-conductors, nuclear engineering of producing reactors, atomic bombs and so forth. It had long been believed until the nineteenth century that Newtonian mechanics was a law governing all over the world. As a result, however, there became dominant the so-called mechanistic conception of nature, a point of view relating philosophically to metaphysical materialism; namely, if God would only give a first impulse, then the world should undergo a prescribed movement subjected to Newton's law after that. Standing on this point of view, only Newtonian mechanics is the Queen of all sciences, and all the rest could be derived from it. This is a view that regard not only the nature but also social phenomena as being essentially regulated by Newtonian mechanics. French materialism was typical in the sense that it took such a point of view as its back ground. In other words, the belief in Newtonian dynamics was so strong that it made this point of view dominant. During this century, a new world was discovered where Newtonian mechanics no longer holds true. The recognition of the fact that every law has its limit of applicability is really the first distinctive character of the present-day science.

5. Existence of infinite strata of matter each having its own law

On the other hand, there has been developed another conception that nature is composed of infinite strata which are different from each other qualitatively, and that every stratum is subjected to its own law. This conception is the foundation of the dialectic view of nature, and was first proposed by Engels in the middle of the nineteenth century. This we may regard as the second distinctive character of the present-day science. At the beginning of the nineteenth century, an idea that matter is composed of atoms was revived by Dalton in modern chemistry. Later on, it became clear that
there existed another stratum named molecules as a basis of matter, besides the stratum of atoms. In this century, however, it has been discovered that an atom is also composed of a nucleus and electrons, and a nucleus is further built of neutrons and protons. We call those constituents of atoms elementary particles. Thus, the level structure of matter has been revealed step by step in that there are atoms in a molecule, elementary particles in an atom. Today, we feel it necessary to push our investigations standing on such a structural point of view presupposing that even the elementary particles might no longer be the ultimate of matter, although they are now regarded as being the smallest unit of matter. In the world bigger than individual molecules, there emerges at a certain point a series of high polymers, a matter of new stratum which is different from usual ones qualitatively. For example, the protein molecules as the basic materials of living bodies, the cells composed of such proteins and others are the strata, respectively. Similarly, living bodies and specifically the human beings among them, too, may be considered as one or the other of the strata. When human beings organise together as a society, this is also a stratum. In other words, the human society belongs to one of the infinite strata in nature; hence, natural science and social science are related to each other in this sense. Turning our eyes to a much bigger region, the earth is also one of the strata, as well as our solar system. There are still a lot of stars like the sun, and they gather to form a nebula called the Galaxy. A nebula can be also regarded as a stratum, but there are lots of nebula in space. In the natural world there exist infinitely many strata, and they combine themselves into a complex network rather than forming a one-dimensional series from the large to the small. And in each stratum, there governs each own law which exerts the greatest predictive power within its limit of applicability. Newtonian mechanics was constructed essentially unifying the world of our visible bodies and heavenly bodies, it plays, within such a stratum a role of the highest law of nature. However, in the world of atoms, molecules and elementary particles, there existed different laws, i.e., the laws of quantum mechanics. The laws discovered by Marx in human society have also a great power as such valid in the stratum of human society. In general, there govern respective laws for each stratum of nature. The aim of individual branch of science is to obtain the knowledge of such a law. Therefore, the existence of infinitely many strata in nature means, equivalently, that every law has its own limit of applicability.

6. Strata under mutual transformations, nature under evolution

The third important point that the present-day science has disclosed is the fact that these various strata form a evolving history, in which each of them is occurring, disappearing and changing to one another everlastingly.

The method of modern science that began at the Renaissance was the one by which one separated an object into pieces and studied each part in full detail. As a result, various sciences have been established such as physics, chemistry, biology, geology and so on. The specialisation, so to say, under which each branch of speciality is investigated deeper and deeper, played certainly an important part as a method of the modern science. This point was emphasised also by Descartes. However, it has been shown by the progress of atomic physics in the twentieth century that those sciences separated into each other in the modern science should be synthesised again after all. Whereas Greek science was of a very synthetic aspect, such a character was lost completely in the modern science, and each learning has been pushed forward separately; the modern science made its way digging deeper and deeper in its speciality, almost losing the connection among each other. This tendency has been continuing even today. Although the progress of atomic science requires a unification of sciences to connect various branches of the present-day science on the one hand, yet almost all of scientists today have not gotten rid of the method of modern science on the other. Recently, in the field of the so-called big science, gigantic instruments are used and a large number of people should work together in a laboratory. Consequently an individual researcher in a huge organisation misses his direction even on his own study, because he plays merely a part as a gear wheel in a complex machine. Even more, he thoroughly loses his perspective about the relation between other branch of science and his own, or between science and society. Such a pathological
aspect of specialisation in the modern science has continued even today, and still more we are able to say that it is promoted by the big sciences themselves. Although the present-day science has begun to have a highly unified character as never to be seen along the progress of atomic physics, yet its method has not at all been free from the method of modern science.

Thus, it is not too much to say that the most serious cause which has brought about the crisis to science and mankind today lies on this point, notwithstanding that the progress of atomic physics in this century is actually playing a role to synthesise various sciences together. For example, in chemistry there had been an idea of immutability of elements as a basic principle of chemistry. It was a main task for chemistry to obtain new substances by combining and dissolving those various hundred of elements existing in nature. And it had been believed that atoms were, as the basis of invariance of an element, indivisible and unchangeable particles, keeping their figure until today as God created it for the first time. But science in the twentieth century shocked the foundation of chemistry radically. As a result of the progress of atomic physics, it is that atoms themselves are destroyed and new atoms are made easily in the laboratory today.

So the permanency of an element no longer holds true. On the other hand, it has become clear that when and how the various atoms were composed from elementary particles in the process of evolution of the universe. This is also the problem concerning the origin of elements.

The thermonuclear reaction in H-bombs and others occurs in the stars, and it plays an important role in the evolution of the stars. For example, the sun is burning owing to the mechanism of the formation of helium nucleus from four hydrogen nuclei. In ancient times, the heavenly fire was believed to be entirely different from the fire on earth, and to be a very mystic one since Grecian age. But today it is revealed that the heavenly fire is burning by virtue of nuclear reactions. In the process of the evolution of heavenly bodies, a stratum called the solar system is formed, and the earth is born. Upon the earth, complicated molecules are composed of atoms gradually, and finally an albuminous molecule, which would become the origin of life, is synthesised. Then, life is created, it evolves to generate mankind, and men gather themselves to form a human society, which develops in succession. Such a course of evolution of nature can be traced by the advancement of atomic physics. In our present knowledge the history of matter begins with elementary particles, which are, however, not in the same figures as God created in remote ages, but known to be created with their antiparticles in the laboratory. Hence, they were not created by God, but must be formed in some time of the history of nature. The conception that various strata in nature do not only coexist simultaneously, but also change to one another constantly, thereby creating new strata and forming the whole history of nature; this conception is rather close to the thought of Heraclitus in Greece that whole things change. This is the world view of dialectic materialism which Marx made his background when he wrote Capital in the nineteenth century, and is also the conception of natural dialectic that Engels expounded upon the basis of achievement of natural science in those days. Such a conception has been confirmed further by scientific contents on the ground of the advancement of atomic physics in the twentieth century, and has been developed as the one providing powerful methods to push forward new sciences.

7. The germination of the dialectic view of nature in Marx

As I mentioned before, an original form of the dialectic view of nature was shown by Engels, a staunch friend of Marx, in his posthumous manuscripts Dialektik der Natur. However, in view of the history of thought, I would like to point out that there was already a germination of it in Marx’s early works. As last year happened to be just a hundred years after Capital of Marx was published, a lot of papers were presented in remembrance of it, but they scarcely touched upon this fact in their articles. Marx generally known as a sociologist, worked out Capital and others and as a philosopher, developed materialistic dialectics, yet it was a problem of atoms that he was interested in at the start. The title of his doctoral thesis was “On the Difference between Atom Theories of Democritus and Epicurus”. In-Greek science the atom-theoretic way of thinking was represented by
Democritus, whereas Epicurus was nominated as his successor. But Marx perceived, in his younger days, a grave difference between Democritus and Epicurus with his penetrating eye. Epicurus is popularly famous for the word “Epicurean” after his name, and as for his atom theory, he has only been believed as an expounder of the atom theory of Democritus. However, in reality, Epicurus’ atom theory is quite different in its elements from that of Democritus. Marx had a sharp insight into this point, and on this account, I think that his doctoral dissertation bears a great significance as a basis of the present-day science. A few years ago, Professor Shinsaku Aihara of Osaka University wrote a very suggestive paper entitled “On sciences” in a magazine Tenbo. It is said commonly that the cause of the crisis of science and mankind lies in the limping growth of the natural science over the social science. However, Aihara stated, in opposition to this, as follows; it is not the case, rather it would be ridiculous to think that only one side of culture could be highly advanced whereas another in the same society could not. Already, in fact, Marx’s Capital achieved a great success, he says. I agree with him on this point, and still more I was deeply impressed by his following suggestion. Namely, usual Marxist-economists or Marxist-philosophers scarcely appreciate Marx’s doctoral thesis; and many of those people are considering it as having no relation with Marxism since it was written in the age when he was a Hegelian-leftist, before he became Marxist. Aihara, however, pointed out keenly that all of the germs of his various social-scientific works such as Capital, of his materialistic conception of history and so on are included early in this doctoral thesis. I was moved profoundly by this suggestion, and found it true that a bud of the dialectic outlook of nature could also he contained in this first article by Marx, although I had thought it was developed chiefly by Engels and pushed forward further by Lenin.

8. The analysis of the concept of elementary particles

As is well known, for studying the elementary particles it is necessary to use huge experimental equipment such as synchrotrons and so on. However, it does not always go well by only using huge and expensive equipment. An essential point for any development of the theory of elementary particles is how to analyse the concept of elementary particles. We have been devoting ourselves to the study based upon such a point of view. Democritus in Greece and his successor Dalton in the modern science, conceived atoms as the unchangeable extreme of matter existing behind the transmutations of things. Nevertheless, in the present-day physics we went further toward smaller and smaller regions until we reached elementary particles. In so far as we consider elementary particles from the view of the natural conception of the present-day science formed with the progress of atomic physics, we should not regard it as an extreme of matter but as one of the strata like molecules, atoms, nuclei and so on; otherwise we would not be able to recognise the nature of elementary particles merely by looking at phenomena as they are. Standing on such a point of view, we have developed a theory that there would exist more fundamental particles behind elementary particles. We must throw away the conception about elementary particles that is to regard them, like Dalton or Democritus, as the ultimate of matter. We put the basis of our research on this point of which Marx discoursed for the first time. Engels wrote in his Dialektik der Natur that the essential difference between modern atomism and previous one lies in that the former recognises the existence of various different strata such as celestial objects, bodies, molecules and atoms and it is not the point that an atom is seen as an ultimate of matter. Lenin also wrote a famous phrase in his Materialism and Empirio-Criticism: “The electron is as inexhaustible as the atom”. However, the origin of these thoughts could again be traced back to Marx. If we read the letters exchanged by Marx and Engels, we find that Marx often mentioned that one should not regard an atom as an indivisible ultimate of matter. We can see that this thought had its origin in his doctoral thesis. It originates from his great insight into the difference between the atom theory of Democritus and that of Epicurus. The disparity between them is so subtle that it would be easily failed to be noticed by ordinary people. Democritus conceived that an atom should be the ultimate of matter created by God; therefore, it is extremely perfect and it obeys only a rectilinear motion. On the other hand, however, Epicurus stated the view that the atom should never be perfect and it sometimes deviates from a rectilinear motion. Upon this difference Marx touched keenly. Namely, following the way
of thinking by Democritus, an atom should take a form such as a sphere or a regular polyhedron since it is to be perfect. In fact, Plato thought that the atoms corresponding to four basic elements such as the earth, water, fire and wind, had shapes of different regular polyhedrons, because what God created should be perfect. As for heavenly bodies also, they thought, in Greek science, that all of them should obey circular motion because they were perfect objects. As they analysed various phenomena only in terms of circular motion, they at last had introduced a notion such as epicycles, making the situations awfully complicated. Such a situation was drastically changed to a simple one at a stroke by the heliocentric theory of Copernicus. Later Galileo found, through his telescope, that the moon was not a complete sphere, but had a pitted face and was very ugly. As a result, it became clear that God could not create such an object. At any rate, as far as one follows the way of Democritus, one is forced to think that all things were created by God at first. On the contrary, if we think, like Epicurus, an atom is imperfect, we then begin with investigating the causes of imperfection, turning our eyes to the next basic stratum, and the imperfection of atoms is explained from its nature. By taking such a way of approach in all its phases, the present-day science has disclosed, as a result, the dialectic outlook of nature. On this account, Marx’s doctoral thesis can be seen as a source of thoughts lying behind the present-day science, a source from which Capital was created and quantum mechanics was developed.

9. The philosophy of quantum mechanics

One may blame us for perverting the historical facts if we are talking about quantum mechanics has been developed by materialistic dialectic. On the interpretations of quantum mechanics the so-called Copenhagen’s one was dominant when, thirty years ago, Yukawa developed his meson theory, of which investigation M. Taketani of Rikkyo University and I helped him. The Copenhagen interpretation, prevailing in the science of Western Europe at that time, was essentially based on the philosophy of Niels Bohr, who is known as the founder of atomic physics or quantum theory.

Although I mentioned that the present-day science revealed the dialectic outlook of nature, nevertheless today’s scientists, not he alone, have developed the learning not by standing the dialectic view of nature consciously, but merely by the methodology of the modern science, since the Renaissance age. But it becomes now impossible to develop the present-day science by an old view such as to regard nature, the ground of science, as merely a collection of separated objects. We were deeply impressed with this point in the course of development of Yukawa’s meson theory. In this connection, Taketani published a paper entitled “Dialectics of Nature” in a journal Sekai-Bunka in Kyoto. In those days the Sekal-Bunka was introducing, e.g., the people’s front led by France. This was the journal that survived to the last in a severe oppression in Japan, when there came an extreme world reaction under the influence of the first great panic after World War 1. On account of publishing such an article in the Sekai-Bunka, he was arrested by the special high police and had to spend some months in a police cell. His article was really a remarkable one, being very unique and could be compared even with Capital by Marx. As to the difference of the interpretation between Copenhagen’s and Taketani’s, we may say that the former is discussing the logics of quantum mechanics in its established form, while Taketani’s three-stage theory of methodology or his interpretation of quantum mechanics is discussing it based upon a standpoint of practice to create new things and has achieved a unique development of the dialectic outlook of nature.

It seems very curious that such an important contribution did appear, not in a socialist country where the dialectic materialism is highly appreciated, but in a capitalist country, especially in Japan when militarism was thriving there. However, I am convinced that his work has the greatest significance as a method of present-day science. The philosophers of present times in Japan used to set the limits of their region of speciality very narrow, and confine themselves to it without giving high appreciation to the works by Taketani. In the socialist countries, the textbooks of materialistic dialectics are presented from the research institute for philosophy in U.S.S.R., for instance, but they do not add anything unique to the methodology of the present-day science, they are rather scholastical. On the contrary, Taketani’s work is very unique and contributed greatly to theoretical
physics of Japan since the advent of meson theory. Although a sensation occurred among natural
scientists also in other fields from ours and it had a great influence upon them, there are yet some
philosophers trying to ignore it unreasonably. Taketani’s three-stage theory had an important
meaning in order to discover a new stratum in nature, to recognize the law which is essential there,
and it was actually successful in developing modern physics. He discovered and elaborated his
three-stage theory in the history of development of quantum mechanics, then he re-examined
Newtonian mechanics from this point of view to clarify its significance for the present age.
According to Taketani’s analysis, the logic of quantum mechanics and that of Newtonian mechanics
do not differ, essentially, from the logic of Marx’s Capital. In other words, Newtonian mechanics
could have a modern significance only when we grasp it by an advanced logic. Just like Capital is
highly established as a social science, Newtonian mechanics is also a very powerful one obeyed by
profound logic within its limit of applicability, although we would be failed if we regard it, like the
scientists in the nineteenth century, as being valid all over the world. In the case of quantum
mechanics, we would lose the perspective to future development unless we grasp it with a highly
advanced logic of, say, Taketani’s interpretation. I think that quantum mechanics, Capital, and
Newtonian mechanics would come to be really powerful theories not only to interpret the world,
but also to change the world and nature when they are understood in terms of such an advanced
logic. As for Taketani’s three-stage theory, I would like to recommend you to read his collected
works, published recently by Keisô-Shobô or a monograph entitled Theoretical Problems at the
Present Age from Iwanami-Shoten, in both of which his theory is presented in detail.

10. A new philosophy for the present-day science

The progress of the present-day science has been supported hitherto by the extension of the
methodology of the modern science initiated in the Renaissance. However, if its development from
now on should still be guided by this methodology, sciences will not only degrade themselves but
also bring about a grave crisis for mankind. Nay, we can say that the degradation of sciences and the
crisis of humankind in present days already stemmed out from this point. As I mentioned before,
nineteenth century’s science separated nature into physics, chemistry, biology, geology, etc., and
took a way to specialization in each field. So it has been thought that there is no relation between
natural science and social science. However, standing on the dialectic viewpoint of nature, the
human society also should be regarded as one of the strata in nature. Various strata are connected to
each other into one, and a unified nature and these strata have been created in the evolution of
nature. In order to advance sciences and to make use of them for the happiness of mankind, we must
combine again those sciences, separated into pieces by nineteenth century’s science, on the basis of
the new outlook of nature and new methodology elaborated in the present-day science. Until they
are combined, I think, today’s science could not be the present-day science in a true sense and could
not play an important role in human history. Were it to be the case, the outcome of science would be
nothing but such as but the Auschwitz, the Hiroshima and the Vietnam, which should never happen
again. In the symposium, of which content is presented as an opening article of this book, Goro
Hani pointed out that the thoughts, philosophies, sciences and arts cannot be entitled to be the
present-day thoughts, present-day philosophies, present-day sciences and arts as long as they do not
start with the Auschwitz; this is truly a sensible remark. Hani also stated there that he had never
been moved so much as when he read for the first time Dialectics of Nature by Taketani, though he
is not a specialist in natural science. I believe that what makes the present-day science to be the real
one is nothing than the theory of methodology as developed by Taketani.

Further, the symposium includes the following discussions: It seems that history comes to the
greatly dangerous turning point when we cast a glance over the trend of history, for example, the
dollar-crisis which occurred recently. The situation is very similar to that around 1930. In that days
Nazism rose later and brought about the cruel affair of Auschwitz by Germany, who had been
glorying in her high level of culture. Fascism rose also in both Japan and Italy ending in World War
II. The fact that there can be seen a resemblance between those days and today, means that the law
of history piercing through them are the same. For example, in the case of Newton’s law the globe or Mars would rotate on the same orbit as now, as far as God do give the same initial impulse to it. Their motion would be modified, however, depending on the way of getting the first impulse. Consequently, assuming both the period of the 1930’s and today are governed by the same law of history, the same accident would happen again if the conditions are the same. But of course we never want such things to happen again. I think it is to prevent them that the world peace movements are taking their actions. Nevertheless, even those people known to be progressive historians in Japan are studying on the premise that fascism will certainly rise up again. Hani emphasised that it is extremely inexcusable. We should just think about what we have to do in order never to allow fascism. It is a duty of the true historians and of today’s scientists to pursue such a direction earnestly. The present-day science should not be the same as the modern science after the Renaissance. On this account, it should take a new point of view worthy of its name, proceed on the basis of new methodology and never walk again the way of the modern science. As I mentioned previously, today’s natural science has been demonised more and more, and the scientist has been reduced to a status like the labourer in a large factory or the salaried man in a big enterprise, losing his perspective to the whole. When scientists lose their total perspective, however, not only would science bring about a crisis to mankind but also the learning itself would revert to the bottom. Reflecting upon the fact that an outcome of Greek science and the modern science after the Renaissance were the experience of Auschwitz, Hiroshima and Vietnam, the present-day science has to take a new way. Namely, it must step forward by making as its own the new methodology and the philosophy, which originated from Marx and include the three-stage theory of Taketani as a zenith.
For hundreds of thousands of years a man's lot was identical with that of the group, of the tribe he belonged to, and outside which he could not survive. The tribe, for its part, could only survive and defend itself through its cohesion. Whence arose the extreme subjective power of the laws that organised and guaranteed this cohesion. A man might perhaps infringe them; it is unlikely that anyone ever dreamed of denying them. Given the immense selective importance such social structures perforce assumed over such vast stretches of time, it is difficult not to believe that they must have influenced the genetic evolution of the innate categories of the human brain. This evolution must not only have facilitated acceptance of the tribal law, but created the need for the mythical explanation which gave it a foundation and sovereignty. We are the descendants of these men, and it is probably from them that we have inherited the need for an explanation, the profound disquiet which forces us to search for the meaning of existence. That same disquiet has created all myths, all religions, all philosophies and science itself.

I have very little doubt that this imperious need develops spontaneously, that it is inborn, inscribed somewhere in the genetic code. Apart from the human species, nowhere in the animal kingdom does one find such highly differentiated social organisations except among certain insects: ants, termites, bees. The stability of the social insects' institutions owes next to nothing to cultural heritage, but virtually everything to genetic transmission. Social behaviour, with them, is entirely innate, automatic.

Man's social institutions, which are purely cultural, cannot ever attain such stability; anyway, who would wish for it? The invention of myths and religions, the construction of vast philosophical systems - they are the price man has had to pay in order to survive as a social animal without yielding to pure automatism. But a cultural heritage would not, all alone, have been strong or reliable enough to hold up the social structure. That heritage needed a genetic support to provide something essential to the mind. How else account for the fact that in our species the religious
phenomenon is invariably at the base of social structure? How else explain that, throughout the immense variety of our myths, our religions and philosophical ideologies, the same essential 'form' always recurs?

**mythic and metaphysical ontogenies**

It is easy to see that the 'explanations', which gave a foundation to the law while assuaging man's anxiety, are all 'stories' or, more exactly, 'ontogenies'. Primitive myths almost all tell of more or less divine heroes whose deeds explain the origins of the group and base its social structure upon sacrosanct traditions; one does not remake history. The great religions are of a similar form, based on the story of the life of an inspired prophet who, if not himself the founder of all things, represents that founder, speaks for him, and recounts the history of mankind as well as its destiny. Of all the great religions Judeo-Christianity is probably the most 'primitive' in its strictly historicist structure, being founded on the saga of a Bedouin tribe before being enriched by a divine prophet. Buddhism, which is more highly differentiated, is based in its original form on Karma, the transcending law governing individual destiny. Buddhism is a story of souls rather than of men.

From Plato to Hegel and Marx, the great philosophical systems all propose ontogenies which are both explanatory and normative. It is true that, in Plato's case, the course is downhill rather than ascending. He sees in history only the gradual corruption of ideal forms, and his aim in the *Republic* is to reinstate the past, to move backwards in time.

For Marx, as for Hegel, history unfolds according to an immanent, necessary, and favourable plan. The immense influence of Marxist ideology is not due only to its promise of man's liberation, but also, and probably mainly, to its ontogenetic structure, the explanation which it provides, both sweeping and detailed, of past, present, and future history. However, limited to human history, even though decked with the certainties of 'science', historical materialism was still incomplete. It needed the addition of dialectical materialism which provides the total interpretation the mind needs: in this, the history of mankind is bound up with that of the cosmos, obeying the same eternal laws.

**the breakdown of the old covenant and the modern soul's distress**

If there is an innate need for a complete explanation whose absence causes a deep inner anxiety; if the only form of explanation which can ease the soul is that of a total history which reveals the significance of man by assigning him a necessary place in nature's scheme; if, to appear genuine, meaningful, soothing, the 'explanation' must be fused with the long animist tradition, then we understand why so many thousand years passed before the appearance, in the realm of ideas, of those presenting objective knowledge as the *only* source real truth.

Cold and austere, proposing no explanation but imposing an ascetic renunciation of all other spiritual fare, this idea could not allay anxiety; it aggravated it instead. It claimed to sweep away at a stroke the tradition of a hundred thousand years, which had become assimilated in human nature itself. It ended the ancient animist covenant between man and nature, leaving nothing in place of that precious bond but an anxious quest in a world of icy solitude. With nothing to recommend it but a certain puritan arrogance, how could such an idea be accepted? It was not; it still is not. if it has commanded recognition, this is solely because of its prodigious powers of performance.

In the course of three centuries, science, founded upon the postulate of objectivity, has won its place in society - in men's practice, but not in their hearts. Modern societies are built upon science. To it they owe their wealth, their power, and the certitude that tomorrow even greater wealth and power will be ours if we so wish. But there is this too: just as an initial 'choice' in the biological evolution of a species can be binding upon its entire future, so the choice of scientific practice (an unconscious choice in the beginning) has launched the evolution of culture on a one-way path; on to a track which nineteenth-century scientism saw leading infallibly on to a vast blossoming for mankind, whereas what we see before us today is an abyss of darkness.
Modern societies accepted the treasures and the power offered them by science. But they have not accepted - they have scarcely even heard - its profounder message: the defining of a new and unique source of truth, and the demand for a thorough revision of ethical premises, for a complete break with the animist tradition, the definitive abandonment of the 'old covenant', the necessity of forging a new one. Armed with all the powers, enjoying all the riches they owe to science, our societies are still trying to live by and to teach systems of values already blasted at the root by science itself.

No society before ours was ever torn apart by such conflicts. In both primitive and classical cultures the animist tradition saw knowledge and values stemming from the same source. For the first time in history a civilisation is trying to shape itself while clinging desperately to the animist tradition in an effort to justify its values, and at the same time abandoning it as the source of knowledge, of truth. The 'liberal' societies of the West still pay lip-service to, and present as a basis for morality, a disgusting farrago of Judeo-Christian religiosity, scientific progressism, belief in the 'natural' rights of man, and utilitarian pragmatism. The Marxist societies still profess the materialist and dialectical religion of history; on the face of it a more solid moral framework than that of the liberal societies, but perhaps more vulnerable by virtue of the very rigidity which up to now has been its strength. However this may be, all these systems rooted in animism exist outside objective knowledge, outside truth, and are strangers and fundamentally hostile to science, which they are willing to use but do not respect or cherish. The divorce is so great, the lie so flagrant, that it can only obsess and lacerate anyone who has some culture or intelligence, or is moved by that moral questioning which is the source of all creativity. It is an affliction, that is to say, for all those who bear or will bear the responsibility for the way in which society and culture will evolve.

The sickness of the modern spirit is this, and lie at the root of man's moral and social nature. It is this ailment, more or less confusedly diagnosed, that provokes the fear if not the hatred - in any case the estrangement - felt toward scientific culture by so many people today. Their aversion, when openly expressed, is usually directed at the technological by-products of science: the bomb, the destruction of nature, the soaring population. It is easy, of course, to answer that technology and science are not the same thing, and moreover that the use of atomic energy will soon be vital to mankind's survival; that the destruction of nature denotes a faulty technology rather than too much of it; and that the population soars because millions of children are saved from death every year. Are we to go back to letting them die?

This is a superficial reply, confusing the symptoms of the disorder with its underlying cause. For behind the protest is the refusal to accept the essential message of science. The fear is the fear of sacrilege: of outrage to values; and it is wholly justified. It is perfectly true that science attacks values. Not directly, since science is no judge of them and must ignore them; but it subverts every one of the mythical or philosophical, ontogenies upon which the animist tradition, from the Australian aborigines to the dialectical materialists, has based morality: values, duties, rights, prohibitions.

If he accepts this message in its full significance, man must at last wake out of his millenary dream and discover his total solitude, his fundamental isolation. He must realise that, like a gypsy, he lives on the boundary of an alien world; a world that is deaf to his music, and as indifferent to his suffering or his crimes.

Who, then, is to define crime? Who decides what is good and what is evil? All the traditional systems placed ethics and values beyond man's reach. Values did not belong to him; they were imposed on him, and he belonged to them. Today he knows that they are his and his alone, but now he is master of them they seem to be dissolving in the uncaring emptiness of the universe. It is at this point that modern man turns toward science, or rather against it, now seeing its terrible capacity to destroy not only bodies but the soul itself.
values and knowledge

Where is the remedy? Must one claim once and for all that objective truth and the theory of values are eternally opposed, mutually impenetrable domains? This is the attitude adopted by many modern thinkers, whether writers, or philosophers, or indeed scientists. I believe that it is not only unacceptable to the vast number of men, whose anxiety it can only perpetuate and worsen; I also, believe it is absolutely mistaken, for two essential reasons.

• **First**, of course, because values and knowledge are always and necessarily associated in action as in discourse.
• **Second**, and above all, because the very definition of 'true' knowledge rests in the final analysis upon an ethical postulate.

Each of these two points needs to be briefly developed.

Ethics and knowledge are inevitably linked in and through action. Action brings knowledge and values *simultaneously* into play, or into question. All action signifies an ethic, serves or disserves certain values; constitutes a choice of values, or pretends to. On the other hand, knowledge is necessarily implied in all action, while reciprocally, action is one of the two necessary sources of knowledge.

In an animist system the interpenetration of ethics and knowledge creates no conflict, since animism avoids any basic distinction between these two categories: it sees them as two aspects of the same reality. The idea of a social ethic founded upon the so-called 'natural' rights of man also reflects this outlook, displayed, but much more systematically and emphatically, in the attempts to delineate the ethics implicit in Marxism.

From the moment objectivity is made the *conditio sine qua non* of true knowledge, a radical distinction, indispensable to the very search for truth, is established between the domains of ethics and of knowledge. Knowledge in itself is exclusive of all value judgment (except that of 'epistemological value') whereas ethics, in essence *non-objective*, is for ever barred from the sphere of knowledge.

It is in effect this radical distinction, laid down as an axiom, that created science. I am tempted to suggest that if this unprecedented event in the history of culture occurred in the Christian West rather than in some other civilisation, it was perhaps partly thanks to the fundamental distinction drawn by the Church between the domains of the sacred and the profane. Not only did this distinction allow science to pursue its own way (provided it did not trespass on the realm of the sacred); it prepared the mind for the much more radical distinction posed by the principle of objectivity. Westerners often have trouble in understanding that for certain religions there is not and cannot be any distinguishing between sacred and profane: for Hinduism, everything comes within the bounds of the sacred; the very concept of 'profane' is incomprehensible.

But let us return to our main point. The postulate of objectivity, denouncing the 'old covenant', at the same time forbids any confusion of value judgments with judgments arrived at through knowledge. Yet the fact remains that these two categories inevitably unite in the form of action, discourse included. To abide by our principle we shall therefore take the position that no discourse or action is to be considered meaningful, *authentic*, unless - or only insofar as - it makes explicit and preserves the distinction between the two categories it combines. Thus defined, the concept of authenticity becomes the common round where ethics and knowledge meet again; where values and truth, associated but not interchangeable, reveal their full significance to the attentive man alive to their resonance. In return, *inauthentic* discourse, where the two categories are jumbled, can lead only to the most pernicious nonsense, to the most criminal, even if unconscious, lies.

It is in 'political' discourse (and I mean 'discourse' in the Cartesian sense), of course, that this hazardous amalgamation is most consistently and systematically practised. And not by professional politicians alone. Scientists themselves, outside their field, often prove dangerously incapable of
distinguishing between the categories of values and of knowledge.

Animism, we said earlier, neither wants nor for that matter is able to set up an absolute discrimination between value judgments and statements based upon knowledge; for having once assumed that there is an intention, however carefully disguised, present in the universe, what would be the sense of such a distinction? In an objective system the very opposite holds: any confusion of knowledge with values is unlawful, forbidden. But - and this is the crucial point - the logical link which radically binds knowledge and values - this ban, this 'first commandment' which ensures the foundation of objective knowledge, itself is not, and cannot be, objective. It is a moral rule, a discipline. True knowledge is ignorant of values, but it has to be grounded on a value judgment, or rather on an axiomatic value. It is obvious that the positing of the principle of objectivity as the condition of true knowledge constitutes an ethical choice and not a judgment reached from knowledge, since, according to the postulate's own terms, there cannot have been any 'true' knowledge prior to this arbitral choice. In order to establish the norm for knowledge the objectivity principle defines a value: that value is objective knowledge itself. To assent to the principle of objectivity is, thus, to state the basic proposition of an ethical system: the ethic of knowledge.

In the ethic of knowledge it is the ethical choice of a primary value that is the foundation. The ethic of knowledge thereby differs radically from animist ethics, which all claim to be based on the 'knowledge' of immanent, religious or 'natural' laws which are supposed to impose themselves on man. The ethic of knowledge does not impose itself on man; on the contrary, it is he who imposes it on himself, making it the axiomatic condition of authenticity for all discourse and all action. The Discourse on Method proposes a normative epistemology, but it must also be read above all as a moral meditation, a spiritual exercise. Authentic discourse is in its turn the foundation of science, and it gives back to man the immense powers that enrich and threaten him today, that free him but might also subjugate him. Modern societies, woven together by science, living from its products, have become as dependent upon it as an addict on his drug. They owe their material power to this fundamental ethic upon which knowledge is based, and their moral weakness to those value-systems devastated by knowledge itself, to which they still try to refer. The contradiction is deadly. This is what is digging the pit we see opening under our feet. The ethic of knowledge that created the modern world is the only ethic compatible with it, the only one capable, once understood and accepted, of guiding its evolution.

Understood and accepted - could it be? If it is true, as I believe, that the fear of solitude and the need for a complete and binding explanation are inborn - that this heritage from the remote past is not only culturally but probably genetic too - can one imagine such an austere, abstract, proud ethic calming that fear, satisfying that need? I do not know. But it may not be altogether impossible. Perhaps, even more than an 'explanation' which the ethic of knowledge cannot supply, man needs to rise above himself, to find transcendence. The abiding power of the great socialist dream, still alive in men's hearts, would indeed seem to suggest it. No system of values can claim to constitute a true ethic unless it proposes an ideal transcending the individual self to the point even of justifying self-sacrifice, if need be.

By the very loftiness of its ambition the ethic of knowledge might perhaps satisfy this craving for something higher. It puts forward a transcendent value, true knowledge, not for the use of man, but for man to serve from deliberate and conscious choice. At the same time it is also a humanist ethic, for it respects man as the creator and repository of that transcendence.

The ethic of knowledge is also in a sense 'knowledge of ethics', that is, of the urges and passions, the needs and limitations of the biological being. It is able to confront the animal in man, to see him not as absurd but strange, precious in his very strangeness: the creature who, belonging
simultaneously to the animal kingdom and the kingdom of ideas, is both torn and enriched by this agonising duality, expressed alike in art and poetry and in human love.

Conversely, the animist systems have to one degree or another preferred to ignore, denigrate or bully biological man, and to make him fear or abhor certain traits inherent in his animal nature. The ethic of knowledge, on the other hand, encourages him to honour and assume this heritage, while knowing how to dominate it when necessary. As for the highest human qualities, courage, altruism, generosity, creative ambition, the ethic of knowledge both recognises their socio-biological origin and affirms their transcendent value in the service of the ideal it defines.

the ethic of knowledge and the socialist ideal

Finally, the ethic of knowledge is, in my view, the only attitude which is both rational and resolutely idealistic, and on which a real socialism might be built. For the young in spirit that great vision of the nineteenth century still persists with grievous intensity. Grievous because of the betrayals this ideal has suffered, and because of the crimes committed in its name. It is tragic, but was perhaps inevitable, that this profound aspiration had to find its philosophical doctrine in the form of an animist ideology. Looking back, it is easy to see that, from the time of its birth, historical messianism based on dialectical materialism contained the seeds of all the dangers later encountered. Perhaps more than the other animisms, historical materialism is based on a total confusion of the categories of value and knowledge. This very confusion permits it, in a travesty of authentic discourse, to proclaim that it has 'scientifically' established the laws of history, which man has no choice or duty but to obey if he does not wish to sink into oblivion.

This illusion, which is merely puerile when it is not fatal, must be given up once and for all. How can an authentic socialism ever be built on an essentially inauthentic ideology, a caricature of that very science whose support it claims (most sincerely, in the minds of its followers)? Socialism's one hope is not in a 'revision' of the ideology that has been dominating it for over a century, but in completely abandoning that ideology.

Where then shall we find the source of truth and the moral inspiration for a really scientific socialist humanism? Only, we suggest, in the sources of science itself, in the ethic upon which knowledge is founded, and which by free choice makes knowledge the supreme value - the measure and guarantee for all other values. An ethic which bases moral responsibility upon the very freedom of that axiomatic choice. Accepted as the foundation for social and political institutions, and as the measure of their authenticity and their value, only the ethic of knowledge could lead to socialism. It prescribes institutions dedicated to the defence, the extension, the enrichment of the transcendent kingdom of ideas, of knowledge, and of creation - a kingdom which is within man, where progressively freed both from material constraints and from the misleading servitudes of animism, man could at last live authentically; there he would be protected by institutions which, seeing him as both the subject of the kingdom and its creator, would serve him in his unique and precious essence.

This is perhaps a utopia. But it is not an incoherent dream. It is an idea that owes its strength to its logical coherence alone. It is the conclusion to which the search for authenticity necessarily leads. The ancient covenant is in pieces; man at last knows that he is alone in the unfeeling immensity of the universe, out of which he emerged only by chance. Neither his destiny nor his duty have been written down. The kingdom above or the darkness below: it is for him to choose.

Further Reading: Biography | Lorenz | Sartre | Marcuse | Althusser | Feyerabend
Value of Knowledge
STREETS WITHOUT LIGHTS

Thousands of Edisons

Who invented the electric lamp?

The usual answer to this question is: "Edison, a famous American scientist."

But this is not true. Edison was only one of the many inventors to whose work we owe the artificial sun which nowadays lights up our streets and houses.
There was a time when there was not a single street lamp of any description on any
city street. People had to sit at home in the evening with only the dim light of a
tallow candle or a smoking oil lamp.

This ancient oil lamp, shaped something like a teapot, hasn't the slightest
resemblance to our electric light bulbs. Nevertheless, the modern electric lamp
descends in a direct line from this queer looking old teapot, with many changes
along the way--some small and unimportant looking, but all significant.

Thousands of inventors throughout thousands of years have worked to give us a
brighter and better lamp.

A Bonfire in the Living-room

Compared with the lamps which preceded it, this clumsy oil lamp was an elegant
and ingenious invention.

There were times when there was no such thing in existence as a lamp of any kind.
Fifteen hundred years ago, on the spot where Paris stands today, stood a dirty little
town called Lutetia. All the houses in Lutetia were tiny wooden huts with straw-
thatched or tiled roofs. If you had gone into one of these little houses you would
have seen a fire burning right in the center of its one room. In spite of a hole in the
roof the room was full of smoke which would have made your eyes smart and
filled up your lungs so you could hardly breathe.

This fire was their lamp, cook stove and fireplace. It must have been a very
dangerous thing to light a bonfire inside a wooden house and you can easily
imagine how many times their houses must have caught fire and burned up.

People had a terrible fear of fire in those days, and no wonder. They thought fire
was some kind of awful, devouring enemy, always lurking about looking for a
chance to fall on the house and destroy it.

It was only about seven hundred years ago that stoves with chimneys first appeared
in Europe. It was even later here in Russia where until very recently peasants in
some places still lived in "black", that is chimneyless huts heated by stove without
any chimneys whatsoever.

When they started a fire in one of these stoves they had to leave the outside door
open to let the smoke out. And to keep the children from being frozen to death by
the cold air that came in or choked by the smoke in the room, they would put them
to bed even in the middle of the day, and cover them up head and all with their big
heavy sheepskin coats.

A Piece of Kindling Instead of a Bonfire
But someone had the brilliant idea that it wasn't necessary to build a whole bonfire to light the house; that all one needed for this was one small stick of kindling wood. The fire filled the house with smoke and also used up too much wood. So, when they wanted light only, people began to burn one stick at a time instead of a whole pile of wood. They would split up a straight-grained log without knots into slender pieces of kindling wood about a yard long, and light them at one end. That is, instead of a bonfire they used a "kindle-light."

This kindle-light was a wonderful invention for its time. It continued in use for more than a thousand years. Not so very long ago it was still used in some out-of-the-way Russian villages.

But it was hard to keep these pieces of kindling burning. If you have ever tried to start the fire in a samovar with a piece of burning kindling you know how it has to be held at an angle, burning end down. Otherwise it will go out.

Why? Because the flame always goes upwards along the wood. This is because the air near the burning wood is heated and, as hot air is lighter than cold, this air goes upwards and carries the flame along with it.

So this light had to be held at an angle, pointing downwards, with the flame at the bottom, otherwise it would go out. Now, it would be too tiresome to have someone stand and hold it in this position all the time. So people thought up a very simple device. They made a holder for the light by setting a straight stick upright in a stand, with an iron clamp on the top to hold the light in the right position.

This wasn't so bad a light as you might think. In fact this kindle-light gave a very satisfactory light. But what a lot of smoke and soot! And what a lot of work and bother with it! They had to keep an iron plate on the floor under it so it wouldn't set the house on fire, and had to keep putting in new sticks every little while. It was usually the job of one of the children to look after the kindle-light while the grown-ups worked.

**Torchlight**

It wasn't always easy to find the right kind of wood for these kindle-lights. But people weren't daunted by this difficulty. Someone noticed that kindle-lights made of pitchy wood burned much better than any others; that is, that it wasn't the wood
so much as the pitch that was doing the burning. They found that any kind of wood, smeared with this pitch, would burn as well as or better than those made of the pitchy wood itself. This was the origin of the torch.

Torches gave a very bright light. Whole rooms could be lighted up with them when great feasts were held. There is a story of how, in the hall of Gaston de Fois, twenty servants, holding torches, stood about the table during supper. In royal palaces there were often silver statues to hold the torches instead of living servants.

Torches, and kindle-lights too, may still be seen occasionally. In some places the firebrigade goes roaring through the streets with flaming torches, recalling those days of long ago.

The First Lamp

When they couldn't get pitch, people used to make torches by soaking the wood in some other inflammable material, such as grease or tallow. Besides giving a better light, the torch had another advantage over the kindle-light--it burned longer. It is easy to see why: there was much more pitch in a torch. This suggested the idea that the wood might be discarded entirely and only the pitch or tallow used. So they began putting the pitch or tallow into a cup of clay or stone and setting fire to it.

This was the first lamp. It would burn for several hours at a time, instead of only half an hour like a kindle-light.

Now, the next problem was to get rid of the smoke and soot. For this primitive lamp smoked horribly.

Lamps and Smokestacks

Why do lamps smoke?

For the same reason that the smokestacks of a factory smoke. If you see thick black smoke coming out of the smokestacks of a factory that burns wood you may be sure that that factory either has poor furnaces or that the fireman doesn't understand his business. Only a part of the wood is being consumed in the furnace, the rest of it is going off up the chimney. Of course it is not going up in the form of wood, but as soot--that is, tiny particles of carbon which have not been burned up.

The trouble is you can't have fire without air. To get the wood to burn up entirely the fireman has to regulate the amount of air entering the furnace by opening or closing the damper in the chimney. If there is too little air in the furnace part of the wood will not be burned up, but will go off up the chimney in the form of soot. If there is too much air it is bad, too, because this will cool off the furnace.

Smoke, then, is soot--that is, tiny particles of carbon. But how does this carbon get into the lamp flame? From the kerosene or oil or pitch, or whatever we burn in the lamp. It's true we can't see any carbon in kerosene or pitch. But can you see sugar in your tea or cottage cheese in your milk? If a kerosene lamp is properly trimmed it will not smoke. All the carbon is burned lip in the flame. But the lamps of olden times, unlike ours, smoked all the time. They didn't have enough air, you see, so
tile little particles of carbon couldn't all be consumed in the flame. The reason they
didn't have enough air was that they burned too much grease or oil at a time.
Something had to be done so that only a little oil would be fed to the flame at it
time. And someone thought up the idea of using a wick.

The wick was made of hundreds of threads, each thread a little tube through which
the oil was fed little by little to the flame, just as ink soaks up into blotting paper
when you hold it in the inkwell.

The Teapot-lamp

The very first lamps looked like our little night lamps or the lamps which burn in
churches before the altars. They were simply little bowls with a wick stuck in
tallow or oil. Even in those days they had begun to burn vegetable oil in place of
tallow in the little church lamps. This vegetable oil was first brought from the
Orient by Arab merchants. Europeans hadn't yet learned how to make it. Later,
when the people in European countries had learned how to make this vegetable oil,
they stopped using tallow in their lamps.

Now the wick in the lamp gradually burned down. It had to be pulled out
continually. In order to do this more easily a specially shaped lamp was devised,
with a spout on the bowl, through which the wick was inserted into the oil. It really
was made exactly like a teapot. Sometimes lamps had more than one spout--very
big ones, as many as twenty.

These lamps were suspended from the ceiling by chains, with a smaller shallow
bowl hung under them to keep the oil from dripping down on the table or floor
beneath. The wicks were made of hemp and peddlers used to go about the streets
hawking them and calling out:

Buy fresh wicks for your spout
So your lamp won't go out!

A Lamp without a Bowel

The indispensable things in a lamp are the oil and the wick--the bowl isn't so
important.

Why how in the world could we get along without the bowl?

That's very simple. All you have to do is to dip the wick into hot melted tallow and
then take it out again. The whole wick will be covered with a layer of tallow and
when it cools you have a candle.
That's the way they made candles in olden times. They would tie several dozen wicks to a rod and let them all down at once into a kettle of melted tallow. They dipped them in several times so there would be a thick coating of tallow on the wicks. Such candles were called "dips". Most housekeepers made their own candles instead of buying them.

Later they learned to pour candles in special molds made of tin or pewter. The molded candles were, of course, much better looking than the dipped ones. They came out smooth and even. Candles were made of wax, too, as well as of tallow. But they were much more expensive, so they were used only in churches. Even kings could permit themselves this extravagance only on festive occasions. Sometimes at big celebrations the royal courts would be lighted up with hundreds and hundreds of wax candles.

Even tallow candles weren't so cheap. As recently as a hundred years ago whole families would spend their evenings by the light of a single candle. When they had guests they would light up two or three candles and everyone thought this was a very brilliant illumination.

How comical it would seem to us to have a dance by the light of three tallow candles! We think even a 60-candle power light weak. We shouldn't be satisfied with stearine candles even, yet our ancestors had only tallow ones, which weren't nearly so good as those of stearine.

A tallow candle always smokes. Worse than that, it has to be continually snuffed. If you don't snuff it the candle gets covered with drippings. The reason is that the tip end of the wick, which extends out beyond the flame, doesn't burn up entirely and gets longer and longer. This makes the flame bigger, just as in a kerosene lamp when you turn up the wick. The big flame melts more tallow than is necessary and it runs down the sides of the candle.

So the wick had to be kept trimmed with a pair of special scissors called snuffers. These snuffers were usually kept on a little tray near the candle.

It was considered very bad manners to pinch off the end of the wick with one's fingers. And the charred end of the candlewick must be thrown on the floor and stepped on so that "no evil smell should offend our nostrils."

In the stearine candles of today the wicks are so made that they don't have to be snuffed. This is because the hottest part of the flame is not inside where it is difficult for the air to penetrate, but on the outside where there is more air.

You can easily prove this for yourself. Take a sheet of paper and hold it for an instant over the candle flame; a little circle will be burned in the paper; this shows that the flame is not so hot in the center as on the outside. In a tallow candle the wick is in the center of the flame all the time, so it doesn't burn well and gets a charred end.

In a stearine candle the wick is not twisted as in a tallow candle. It is braided. This tightly braided wick keeps unwinding at the end and these ends stick out into the hottest part of the flame and are consumed as the candle burns down.
A Candle Clock

In olden times when a man was asked what time it was he used to look at a candle instead of at a clock. And this was not because he was absent-minded, either, but because in those days candles were used not only to give light but also to measure time.

They say that in the chapel of Charles the Fifth a big candle was kept burning night and day. This candle was divided into twenty-four parts by black lines, denoting the hours of the day. Special servants were detailed to tell the king from time to time how far down the candle had burned.

This candle was no small one, of course. It was made just long enough to burn exactly twenty-four hours.

Centuries of Darkness

After the invention of torches, oil lamps and candles people were satisfied with this poor light for a long time. They were really wretchedly poor lights. Not only that, they also smoked and sooted and sputtered and guttered. It was enough to give anyone who wasn't used to it a headache.

Portable lanterns had chimneys made of metal sheets with holes punched in them, like a sieve. Only a small part of the light could get out through these holes.

No one had ever thought of such a thing as street lamps. Except on moonlight nights it was pitch dark on city streets at night. And street lamps were needed then even more than now, for the streets were not paved and the ground was rough and muddy and covered with filth.

Gutters ran down the middle of the streets to carry off the sewage. People walking along the street tried to keep close to the houses. But this was almost as bad, for at any moment someone might empty a pail of slop out of an upstairs window right down on their heads as they passed.

To insure themselves against such an unhappy fate, people who could afford it used to have servants go ahead of them with lighted torches to light up the way.

THE FIRST STREET LIGHTS

Night and Day

IN OLDEN times people, both those who lived in cities and those who lived in the country, began their day with the dawn and ended it when the sun set. There were no factories. There was no such thing as night work. All manufactured articles were produced in artisans' workshops. Everybody went early to bed and everybody got up early in the morning. There was no special need for lamps or street lights.

However, as industry developed, when large workshops, manufactories, began to appear, and a little later, factories, city life became an entirely different thing. The
factory brought in the long working day and the night shift. Factory whistles shrieked long before daybreak, calling the workers to their jobs. Cities began to waken up earlier and go to bed later. Life in them ceased to be measured by the sun. Days grew longer, nights shorter. This made lamps and street lights a necessity. Light, bright and inexpensive light, was urgently needed.

Then began the work of inventors, which led eventually to gas and electricity. This, of course, did not happen all at once, any more than the old mediaeval town changed all at once into a modern manufacturing city. Our electric light has a long line of ancestors.

The Mysterious Disappearance of the Candle Flame

At first the inventors tried to improve the oil lamps. Now the first thing they had to know in order to make a good oil lamp was what happens to oil when it burns. They had to find out exactly what combustion is. It was only when this problem had finally been solved that good lamps began to appear.

If we put a burning candle into a jar and close the jar, the candle will burn all right for a while. But in a few seconds the flame will begin to die down and finally it will go out. If we take the candle out, relight it and put it back into the jar it will go out immediately this time. Now, there is still air in the jar, but there is something lacking in it, something which is necessary to produce a flame.

This "something" is a gas which is one of the component parts of air. It is called oxygen. When the candle burns, oxygen is used up and disappears. But this still doesn't explain exactly what combustion is. We see that the candle has gone out and furthermore that something has happened to the oxygen. What is the secret of this mysterious disappearance?

The explanation is that it only seems to us that the candle flame has gone out.

If you put a drinking glass over a candle flame it will be coated inside with soot and drops of water will form in it. This shows that water is given off in the process of combustion. But besides water, which we can see, another substance is given off, an invisible gas, carbon dioxide. When we put the burning candle into the jar, a layer of this carbon dioxide collected at the bottom of the jar and the candle could not burn in this any more than it could in water.

This carbon dioxide can be poured out of the jar like a liquid. If we then put the lighted candle back into the jar it will not go out at once. It will burn until another layer of carbon dioxide has collected.

That is, when a candle burns, neither the candle nor the oxygen in the air are destroyed. They are merely changed into carbon dioxide and water vapor.

Formerly this was not known. A little more than four centuries ago there was only one man living who had figured out what combustion really was. This was the Italian artist, scientist and engineer--Leonardo da Vinci.
A Lamp with a Samovar Chimney

Leonardo da Vinci even in those early days understood that soot was due to an insufficient supply of air. He came to the conclusion, too, that to supply sufficient air there must be some kind of draft like that in a stove, that a chimney must be put over the flame. Then the heated air would go off up the chimney, carrying with it the carbon dioxide and water vapor, and fresh air would come in from below with plenty of oxygen in it.

So the lamp-chimney was invented. At first it was made of tin, like the chimney of a samovar, instead of glass. And it wasn't put right on the lamp bowl, as glass chimneys are, but was placed up above the flame. It was some two hundred years later that a French apothecary named Quinquet had the bright idea of substituting a transparent glass chimney for the original one made of tin which would not let the light out. But even he didn't realize that since the chimney was transparent it could be put lower down, right on the burner. It was not until thirty-three years later that Argand, a Swiss, realized this fact, which you would think anyone would have seen at a glance.

Complicated Lamps

So, little by little, the lamp was made up, part at a time. At first only the bowl for holding the oil, then the wick, and finally the glass chimney. But even this lamp with the glass chimney didn't burn any too well. It didn't give any more light than a candle. The oil didn't run up the wick very well; not so well as our kerosene. And you know there wasn't any kerosene in the world in those days.

Try dipping a piece of blotting paper in kerosene and in melted butter. You will see that the kerosene is sucked up very much faster. So the flame was small because the oil ran up the wick so slowly. Some way must be devised to force the oil to feed into the wick faster, if it wouldn't go of its own accord.

It was a mathematician, Cardan, who lived fifty years later than Leonardo da Vinci, who thought up how to do this. His idea was to put the bowl containing the oil above the burner so that the oil would flow down to the flame by the force of gravity, like water from a water faucet. He then connected this bowl with the burner by a little pipe through which the oil flowed down.

Another inventor, Karsel, had the idea of using a pump to force the oil into the burner. He devised an elaborate mechanical apparatus, a pump run by clockwork, which forced the oil into the burner. Karsel lamps of huge size are still used in lighthouses, because they give a very steady light.

Finally there was a third inventor who put a ring and a spring into the lamp bowl. The spring pressed on the ring and the ring pressed on the oil and forced it to rise up through a pipe into the burner. Such lamps were in use up to within a very short time; our grandfathers and grandmothers used them.

The Argand Lamp
However, none of these elaborate lamps burned so well as our present day kerosene ones, although they were so much more complicated. The trouble was that the wicks weren't good. They still used twisted wicks like those in tallow candles. And these wicks had the same kind of flame, too, as the candle, only it was larger. No wonder these lamps smoked. No air could reach the center of the flame.

A Frenchman, Leziere, figured out that a wick could be made flat like a ribbon, instead of being round like a cord, like the wicks in our little kitchen lamps. This gave a flat flame and the air could reach all parts of it more easily. Then Argand, the man who had thought up the idea of putting a glass chimney on the lamp, invented the very best kind of wick. His method was simple. He took a flat wick and rolled it into a cylinder. Then he made a burner in such a way that air could get at the flame from both the inside and the outside. This Argand burner is still used in our big kerosene lamps. Try taking one of these burners apart and you will see a little crown with perforations in it to admit the air on top of a metal tube round which the wick is placed. This tube is full of holes through which the air gets to the inside of the wick, and thus reaches the center of the flame.

People were enthusiastic over this Argand lamp. But it had its enemies too. One old authoress, Countess de Genlis, said that "since lamps came into style all the young people have begun to wear glasses. Only older people who read and write by candle light have good eyes."

Of course this is not true. The Argand lamp wasn't in the least bad for the eyes.

**The First Street Lamps**

During these several centuries which separate the teapot lamp from the Argand burner, great changes had taken place on the streets of cities.

Paris was the first city to have lighted streets. It started by the police requiring every householder to keep a lamp burning in a street window from nine o'clock in the evening on through the night.

Soon regular companies of torch- and lantern-bearers began to offer their services to anyone who wished to hire them. And a few years later the first street lamps appeared in Paris.

This was a great event. King Louis the Fourteenth ordered a medal struck to commemorate the occasion. Tourists used to tell the most enthusiastic stories about the impression which the brilliantly lighted streets of Paris made on them. They say that the reign of Louis the Fourteenth is called the "brilliant" because of these street lamps.

It is interesting to read the memoirs of people of those times. I have before me a book, with a long title, after the fashion of those times:

**A VISIT TO PARIS**

DIRECTIONS INTENDED FOR THE USE OF TRAVELING GENTLEFOLK TO ADVISE THEM WHAT TO DO IF THEY WISH TO MAKE THE BEST USE OF
THEIR TIME AND MONEY WHILE STAYING IN PARIS.
WRITTEN BY THE COUNSELOR TO HIS HIGHNESS PRINCE WALDECK
JOACHIM CHRISTOPH NEMEITZ, PARIS, 1718.

We read on one of the pages of this book:

"One may safely be out on the main streets up to 10 or 11 o'clock at night. At
nightfall street lamps are lighted on all streets and bridges. These burn until two or
three o'clock in the morning. These lamps are suspended on chains at regular
intervals along the middle of the street. They make a very beautiful sight,
especially when one stands at an intersection and looks down the different streets.

Some shops, cafes, taverns, and tobacco shops remain open until ten or eleven
o'clock at night. Their windows are illuminated with an enormous number of
candles which cast a brilliant light on the street. In fine weather there are as many
people on the streets at night as in the daytime. Thefts and murders are of rare
occurrence on these crowded lively streets. But I would not guarantee that you
might not be robbed on the little streets. I do not advise anyone to go about the city
on a dark night. For, although there are mounted watchmen on guard throughout
the city, nevertheless things happen which they do not see.

Not long ago the carriage of the Duke of Richmond was stopped at midnight by
unknown persons not far from the New Bridge. One of the group forced himself
into the carriage and ran the duke through with his sword.

After ten or eleven o'clock at night it is impossible to find a porte-chaise or a fiacre
for hire. The best thing is to take a servant along to walk ahead with a torch."

In 1765, Paris installed a new kind of street lamp, "reflector" lamps, using oil lamps
instead of candles, with bright reflector-plates. Some kerosene lamps are still made
with these reflectors. This new kind of street lamp was in use for many years. One
of them, at the corner of Vanner Street and Place de la Greve, became famous
during the great revolution, for on it the revolutionary citizens of Paris hung royal
officials and courtiers. Once a certain abbot, who was being dragged to the lamp
post to be hanged, saved his life by shouting: "Very well, hang me then, but will
that make your light any brighter?"

London was lighted up twenty years later than Paris. One inventive man named
Edward Hemming agreed, for a small sum, to place a street lamp at every tenth
door. True, he didn't need to have them there all the time, only on moonless nights;
and not all the year round, only in winter; and not all night but only from six
o'clock to midnight. But nevertheless his proposal was received with the greatest
enthusiasm. They hailed him as an inventive genius; said that "the inventions of all
other inventors were nothing in comparison with the achievement of this man who
had turned night into day!"

Here in Russia as recently as a hundred years ago our streets were still lighted with
oil lamps. Gogol has left a description in his story, "Nevsky Prospekt," of how the
streets of Petersburg looked in those days:

"As soon as dusk falls on the houses and streets, and the watchman, covering his
head with a piece of matting, scrambles up the ladder to light the street lamp,
GAS AND KEROSENE LIGHTS

A Gas Factory in a Candlestick

It wasn't very cheerful a hundred years ago to spend the evening by the dim light of tallow candles or oil lamps. It was hard to read, almost impossible if the print was fine.

When the lamp was lighted it would burn for a time but in about half an hour it would begin to die down. The heavy rape oil didn't feed well. The wick would get charred at the end. The lamp had to be relighted about every two hours.

People began to think about getting something else in the place of oil. And, sure enough, a new fuel made its appearance. Long years ago the "kindle-light" had been replaced by oil, now this oil was replaced by a gas, illuminating gas. How could they burn gas in a lamp and where did they get it?

If you put out a candle you will see a white smoke rising from the wick. You can light this smoke with a match. The flame of the burning smoke jumps from the match to the wick and the candle lights up again.

A candle is a little gas factory. When stearine or tallow is burned it first melts, then turns into gas and water vapor, which is what we see when we put the candle out. Burning gas and vapor, that is what a flame is. The same thing happens in a lamp, too. The oil or kerosene is turned into gas and water vapor which burn, thus making the flame.

The First Gas Works

Someone conceived the idea that combustible gas could be obtained in a gas plant instead of in a lamp, and that from this gas plant it could be piped to burners in different places. But instead of tallow or oil he used coal, which is cheaper.

This man's name was William Murdock. He is the same Murdock who built the first steam engine in England. Murdock was a workingman at first, and later an engineer in the factory belonging to Boulton and Watt. This was the first locomotive works.

In this famous factory Murdock built his gas plant, and it was not an easy thing to do. He knew that in order to get a combustible gas he had to heat his coal white hot. But if coal is white hot it will burn up and there will be no gas. How could he get out of this dilemma?
Murdock's solution was a simple one: instead of heating the coal in an open furnace he used a closed one, a "retort", into which no air could penetrate. Combustible gas does not burn without air and it could thus be piped to any place desired.

But there was still another difficulty. Gas isn't the only thing obtained from coal when it is burned. There are also soot and water vapor. As the gas comes out of the retort it cools and these vapors liquefy. Now, if the gas were allowed to pass through the pipes in this form these liquids would quickly settle in them and clog them up. To prevent this the soot and water are very carefully separated out at the plant. The gas is cooled by passing it through a series of perpendicular pipes, cooled on the outside by air or water. In this cooler the water vapor and soot condense and settle to the bottom, the gas goes on through the pipes to the burners.

At the same time that Murdock was carrying on his experiments with gas lighting a Frenchman named Lebon was doing the same thing. In 1811, in a journal entitled *Magazine of All the Newest Inventions, Discoveries and Improvements,* there appears the following notice:

M. Lebon has shown that a pleasant heat and a very brilliant light can be obtained by carefully collecting smoke and burning it. The inventor gave a demonstration of his invention and seven rooms and a garden were successfully lighted up with this new light. The inventor calls his apparatus a "thermo-lamp," that is a "heat-light."

It wasn't nearly so hard to think up a good gas burner as it had been to think up a lamp. All that was necessary was to put a little cap on the end of the gas pipe, with a slit in it to let the gas out, and it gave a brilliant flame. Later the principle of the Argand lamp was used here too. In the Argand gas burner there are many little openings arranged in a circle, to permit the air to reach the center of the burner. And, as in a kerosene lamp, a glass chimney is placed over the burner.

At the time of the appearance of gas light, oil lamps had reached such a state of perfection that all the inventors of gas burners had to do was to adapt them to the new uses.

Gas made as much of an impression on people in those days as the invention of radio and aeroplane did in our day. It was the talk of the time. They wrote in the newspapers: "Day and night one can keep a fire burning in the room without having to give it the least attention. It can be suspended from the ceiling and lights up the whole room and doesn't have to have a candlestick to cast a big shadow, and it doesn't smoke at all."
In the humorous periodicals of the day one finds many verses, cartoons, and caricatures about gas lighting. In one of these caricatures there is a fashionable lady with a dirty beggar woman standing beside her. In place of a head, the lady has on her shoulders a brilliant gas light—the beggar woman has an oil lamp. In another picture there is a gas lamp dancing about on slender legs near an ugly sputtering tallow candle. Under this candle, as if under a tree, there are two figures seated: an old man with a book in his hand and an old lady knitting a sock. They are evidently making a great effort to do their work by the dim candle light. Melted tallow is dripping down on their heads.

Now all large cities have gas works. The gas is taken along the streets through underground pipes, like water pipes. The only difference is that a water tank is always placed as high up as possible so that the water will have pressure enough to reach the upper stories of the houses; while the gas plants are always built in the lowest part of the city. Gas is very light and goes up more easily than it goes down.

Illumination is not the only thing for which gas is used. Gas cook-stoves are in common use both in foreign countries and here (in Russia).

**A Swell, a Shoemaker, and a Lackey**

For some time after gas lamps were burned in the streets, houses were still as dark as ever. It was too expensive to light houses with gas. And the oil lamps and tallow candles burned wretchedly. They say that the writer Belinski used to have an oil lamp standing on his work-table but that he never lighted it, because he couldn't bear the smell of the burning oil. He always worked by the light of two candles.

The problem of some better fuel for illumination was still unsolved. But instead of looking for something new they tried to improve what they had. They found out that, in place of the soft, greasy tallow candles, they could make nice hard candles, candles that wouldn't soil one's hands, wouldn't sputter when they burned, and wouldn't smoke. All that was necessary was to purify the tallow, or rather to separate out its best and firmest part, stearine.

Tallow consists of several things: glycerine and fatty acids. And the fatty acids are not all the same! Some of them are hard, this is stearine. Some of them are soft,
this is olein. To extract the stearine from the tallow one must first of all get out the glycerine. To do this the tallow is boiled in water and sulphuric acid. The fatty acids float to the top, leaving the glycerine at the bottom. The stearine is then squeezed out from the olein in presses. Hard cakes of stearine are obtained, and this is melted and molded into candles.

Stearine candles were invented in France. Soon stearine factories sprang up all over Europe. Here in Russia a stearine factory was started in St. Petersburg, the Nevski Stearine Works. It is still in operation.

People were delighted with the new candles. And no wonder. Just compare them with the old tallow and wax candles. Hear what V. L. Petrovski, brother of the famous revolutionist, Sophie Perovskaya, has to say about the new stearine candles:

In those days rooms were lighted in the evening by tallow candles. Even on card-tables lights of this kind were placed. To snuff off the charred ends of the wicks there were special snuffers, lying on a tray. Often the snuffers and the tray were both of silver. We also sat and worked in our rooms by such lights.

Once my father went to Petersburg on official business and brought home with him a novelty, a whole box of stearine candles. On our next holiday, the fourth of December, mother's name-day, we gave a ball. The dancing-hall and all the other rooms were lighted by these stearine candles, placed in candelabra and wall brackets. The effect was tremendous and our party was crowded with people eager to see the new kind of illumination.

There is a picture in an old magazine representing two stearine candles as an elegantly dressed couple, standing proudly in the center of the scene, with big candles on their heads. At the right stands an untidy-looking shoemaker with a tallow candle on his head. The tallow is dripping on his ragged clothes and hanging like icicles from his nose. At the left is a liveried servant with a wax candle. Both the wax and the tallow candles are smoking horribly, while the stearine ones are burning bright and clear.

To understand this picture you have to remember that in those days servants and shoemakers were considered of much less importance than any silly fop.

An Easy Riddle

So the problem of the candle was finally settled satisfactorily, but lamps were as bad as ever. No matter how many clever devices they thought up, no matter how many springs and pumps were added, lamps continued to burn wretchedly. And no wonder, for no matter how much the lamp burner was improved it wouldn't help--because the trouble was not in the burner but in the fuel. As soon as people learned how to get kerosene from petroleum--this was in the middle of the last century--all their difficulties vanished.

All their ingenuity had been wasted in trying to devise some way of making a fuel burn well which by its very nature burned badly. It's quite another story with kerosene. It runs up into the wick much more easily than oil. So the inventor of the
kerosene lamp, an American named Silliman, didn't have to think of anything new. All he had to do was to discard all the unnecessary parts of the old lamp, the pumps and springs, all the contraptions that had been used to force the oil into the wick.

That's the way it often is: people puzzle and worry and think up all kinds of complicated apparatus, and in the end it turns out that the answer is very simple. All that is necessary is to find the clue. Kerosene was this clue.

A FLAMELESS LAMP

A Poker and a Lamp

EVERYONE knows that a poker is not a lamp. But a poker can be made to give light. All you have to do is to hold it in the stove for a long time. It keeps getting hotter and hotter until it finally becomes a dark red color.

Keep on holding it in the fire and it will get cherry red, then bright red, then yellow and finally white.

(You can't heat a poker white hot in an ordinary heating stove. To do that you must have an intense heat, one that cannot be measured by the ordinary thermometer, 1300 C.)

Take a candle or lamp, any kind of lamp, electric, gas, kerosene, or any other kind, they all give light for the same reason that the poker does--because they are raised to a very high temperature, are incandescent. In the flame of the candle and the lamp there are tiny particles of incandescent carbon, floating like the dust motes in a ray of sunlight. We don't see them ordinarily. They are visible only when the lamp smokes. Now, sooty smoke is very disagreeable. But it would be a great misfortune if there were no soot--that is, tiny particles of unburned carbon in the flame. The flame of burning alcohol, for instance, has no soot in it and for that reason gives hardly any light.

So it is incandescent carbon that is doing the work. But carbon can be heated white hot without fire, by means of an electric current, for instance. That's what the inventor of the first electric lamp did, used an electric current in place of fire.

A Flameless Lamp

If you had told a man living a hundred years ago that sometime a lamp would be invented that would give light without fire, he would have thought it absolutely impossible. Yet even at that time the first experiments for obtaining electric light were being carried on in laboratories. As now, perhaps, somewhere in the quiet of a laboratory, an as-yet-unknown inventor is working away on some wonderful discovery that we don't even dream of.

The first flameless lamp was invented by an English chemist, Sir Humphrey Davy. It was not an easy thing for him to work on this in those days when so little was known about the electric current and so few knew even that little. There was no such thing as a machine for producing electricity, and no one had ever thought of
such a thing as a power station. The current was produced only in scientific laboratories by the aid of batteries composed of galvanic cells.

Don't be frightened by this high sounding name. You have undoubtedly seen batteries in a pocket flash-light or in a box in the hall near the electric door bell.

I shall not take the time to explain in detail the construction of this battery. The important thing is that the electric current is produced in the cell and goes from it along a wire to the lamp in the flashlight or to the bell. It then returns to the cell along another wire. The cell is like a pump. Just as a pump sends water along the pipes so the cell sends the electric current along the wire. The terminal through which the current passes out of the cell into the wire is called the positive pole and is designated by the sign +, the one by which the current returns to the cell is called the negative pole and is designated by the sign -.

To get it strong current several such electric pumps are united together into a battery of electric (or galvanic, which means the same thing) cells.

That's all there is to it.

Humphrey Davy once made the following experiment: he took two little rods of coal and fastened one of them to the positive and one to the negative wire. When he brought the ends of these rods close together the current jumped over the intervening space from one to the other. The ends of the rods were heated white hot and between them appeared an are of bluish flame.

If we could examine this are more closely we should see a whole stream of particles of incandescent carbon flowing from the negative to the positive rod. This makes a protuberance on the positive and a depression on the negative rod. The space between the rods becomes greater all the time, because the coal gradually burns up. To keep the are from going out, the rods have to be brought nearer to each other every little while.

This are is called the "Volta are" in honor of a scientist named Volta. [Note: A Russian, Professor Petrov, discovered the volts are at the same time as Davy. In the are, just as in the flame of a kerosene lamp or a gas burner, it is incandescent carbon that gives the light. The difference is only that here the heat is supplied by an electric current instead of by fire.]
At first this are was only an interesting scientific experiment. It was not possible to use it in lighting because the coal burned up too fast. It was about thirty years before a certain scientist, this time a Frenchman instead of an Englishman, used coke in the place of coal. Coke is what is left after the coal has been burned in gas-plants for making illuminating gas.

Now coke burns more slowly. But this was not all that was necessary. Some way must be devised for keeping the rods near enough to each other all the time. So we find clockworks again used in a lamp. This time to keep the ends of the rods equally distant from each other.

They tried lighting the streets of Paris with are lamps provided with a clock mechanism. One square was lighted up but the mechanism was so costly that it had to be abandoned.

A German Scientist, Gephner Altenek, devised a much cleverer way of keeping these rods near enough together. His are lamp was so complicated that it would take too long and be too difficult to explain it. The essential thing in it was that he put a magnet in his lamp which (at the necessary time) attracted an iron strip attached to one of the rods. The distance between the rods was thus diminished and the lamp continued to work.

As you see, work on the are lamps was going on in all the countries of Europe. Here in Russia an inventor by the name of Yablochkov was working on them. He figured out that the rods should not be arranged one above the other, but side by side, parallel, as shown in the picture. To keep the distance between them from changing he would pass the current first into one and then into the other side. Thus the rods would be alternately positive and negative and first one then the other would burp up more rapidly. The rods were separated from each other by a strip of gypsum which was gradually volatilized by the intense heat of the candle.

These "candles" of Yablochkov gave a beautiful rosy or violet light. They were greeted with the greatest enthusiasm at an exposition in Paris.

The Tables Are Turned
There was a time when people racked their brains over the problem of getting lamps to give a brighter light. And now, several hundred years later, we find scientists doing precisely the opposite. The trouble was that these are lamps were too bright. You can't put a six hundred candlepower lamp on your writing desk. It might put your eyes out and how expensive it would be!

Some way must be found to make the light of the electric lamp less brilliant. So they figured out that it would be simpler to bring the carbon itself to an incandescent heat by means of the electric current, doing away with the are entirely.

If an electric current is sent through a slender carbon filament, the carbon becomes heated. When the temperature reaches 550 C. it begins to give off light. This light is at first red, then it grows whiter and whiter, until finally when a very high temperature is reached it is entirely white. In a word, the same thing occurs as when we heated our poker in the stove.

So they began trying to send the current through the carbon filament. But the filament burned up at once and the lamp went out. To prevent this it was necessary either to exhaust the air or to fill the lamp with some gas which would not support combustion, for example, nitrogen.

Kerosene and oil lamps need air, just as a person does. Without air there cannot be a flame. But here it is just the opposite--air does harm because no flame or combustion is desired. For, you see, the filament is heated by the electric current, not by a flame.

The first good lamp using a carbon filament was invented fifty years ago by the famous American inventor, Thomas Alva Edison. He used a carbonized bamboo filament. To keep this filament from being burned up, Edison very carefully exhausted all the air from the lamp.

The little glass tip which we used to see on electric light bulbs is the remnant of a glass tube through which the air has been exhausted by a pump. When the air is all exhausted a hot flame is applied to the tube, which breaks off. The little end left sticking to the bulb is sealed up. In this way Edison succeeded in producing a lamp which would burn for 800 hours without interruption.

The steamship "Columbia" was the first to use these carbon lamps of 20 candle-power for illumination. And very soon the first consignment of electric light bulbs arrived in Europe, consisting of 1800 lamps.

**War Between Gas and Electricity**

When electric lamps appeared everyone said that this was the end of gas, not to mention kerosene. You see, electricity doesn't smoke or vitiate the air, and it gives a clear white light. And if the wiring is properly done there is no danger of fire. And most important of all, it is generally cheaper than gas.

The people who stood to lose money by the closing of gas- or kerosene-plants began to try to find some way out, began to think how their lamps could be
improved so as to hold their own against electricity.

They began to fight electricity with its own weapon. The carbon filament in the electric lamp burns so brightly because it is raised to an intense heat. That is, it is all a matter of incandescence.

So the supporters of gas and kerosene devised a little sieve, made of a material which has a very high melting point, to place over the flame. This sieve was heated white hot and then it gave a clear white light. These sieves were called "Welsbach mantles" after their inventor, Auer von Welsbach.

For several years victory was on their side. Gas light was now twice as cheap as it had been before, because the gas-burners now gave much more light than formerly. And one lamp would do the work previously done by two. So the cost of gas was reduced.

But the supporters of electricity weren't asleep all this time. They made up their minds that they must get a still brighter and therefore cheaper light. There was only one way to do this--heat the filament still hotter. For you know the higher the temperature the brighter and whiter the light. Remember our poker!

But there was a little hitch here. If the carbon filament is heated too hot it turns to vapor, "burns out" as we say. Something must be found to take the place of carbon.

So they borrowed something from the gas side. In the new gas burners, the light didn't come from incandescent carbon as in the earlier burners, but from the Welsbach mantle, made of a non-inflammable material with a very high melting point.

Why not use a filament made of some such noninflammable, non-fusible material in electric light bulbs instead of the carbon filament?

They first tried making this filament of osmium. Osmium has a very high melting point but the osmium filaments were not sufficiently strong. Another metal was tried, tantalum; and finally tungsten. Tungsten has the highest melting point of all
metals, 3390 C. This is the electric light still in general use.

It is a curious thing that every new lamp took whatever was best from its rivals, the older lamps. Gas and kerosene lamps took over the Argand burner from the oil lamp. The carbon electric lamps took over the idea of incandescent carbon from the gas and kerosene lamps. Then the gas lamp discarded the carbon and used the Welsbach mantle. The electric lamp, too, discarded the carbon filament and the economical lamp with a metal filament appeared.

So one inventor continued the work begun by another and all together worked for a common end.

The whole history of lighting is expressed in the present prices of gas, kerosene, and electricity. The most expensive of all is the old-fashioned gasburner. The later round burners are a little cheaper. Lighting with a kerosene lamp costs only half as much. But the cheapest of all are the latest types of electric, incandescent gas, and incandescent kerosene lamps.

The struggle between gas and electricity is not decided yet. It is difficult to say which will come off the victor.

Which is better, gas or electricity?

Gas is no more expensive than electricity and it gives a clear white light. It is also easy to light. One doesn't have to climb up to the ceiling on a ladder and light it with a match. There are now gas burners which are lighted by means of electricity. (Even here we can't get along without electricity!) Gas may be used not only for light but for heating and cooking also. Excellent gas ranges are in very common use everywhere, also heating stoves and water heaters. There are also electric cooking stoves, and electric saucepans, tea-kettles and frying pans.

Electricity is better than gas in many respects. If there happens to be a leak in the gas-pipe the gas leaks out into the room and may poison everyone in it. It may cause a still greater disaster. If much gas leaks out it mixes with the air and forms an explosive mixture. Then if someone happens to strike a match the whole house is blown up.

If electricity is used for lighting there will be no danger of asphyxiation or explosions.

And even when there is nothing wrong with the gas-pipes, gas vitiates the air in a room. Not only gas does this, any kind of lamp in which combustion takes place will do it. For you remember that air is necessary for combustion. Fresh air goes into the lamp and comes out vitiated, no longer good for burning. The same thing happens when we breathe; we take in fresh air and breathe out bad air. A 25-candle power kerosene lamp uses up about 55 pounds of air in an evening. A person breathes only about 7 pounds in the same length of time. That is, one such lamp in a room is equivalent to 8 persons.

You call see from this that the more people there are in a room the harder it is to breathe, because the fresh air gets less and less.
Electricity is entirely different. Although from force of habit we say that an electric lamp "burns," in reality there is no combustion taking place in it. Therefore it cannot vitiate the air.

Electricity has another big advantage: the current can be taken a long way -- hundreds and hundreds of miles. One big electric power-station can light up a whole countryside. No wonder that nowadays electricity is being used everywhere, even in the most remote villages which were only recently using the old kindle-light.

An Electric Lamp Which Had to Be Lighted

Before an economical electrical lamp had been invented, a certain scientist, Nernst, invented a very curious type of lamp. In place of carbon he used not a metal filament but a rod made of magnesium. Magnesium is a substance which does not burn, that is, it is not affected by air. This was precisely what was needed. But the great drawback was that magnesium is a conductor of electricity only when it is hot. So these first Nernst lamps had to be started with a lighter, like a kerosene lamp. Later Nernst improved on this method of lighting his lamp. But these Nernst lamps are very rarely used. They are too expensive.

The Biggest Lamp in the World

Not long ago a German scientist, Beck, built an electric arc lamp of 2,000,000,000 candle power. At a height of 20 miles above the earth this lamp would give a light equal to that of the full moon. Even at the same distance from us as the moon it would appear to us like a star visible to the naked eye.

The carbon rods in this lamp are heated to 7500 C, that is, hotter than the sun, whose temperature is calculated to be about 6000 C.

This lamp is two metres in diameter.

LIGHT WITHOUT HEAT

The Struggle with Heat

IN OLDEN times people used the same fire as a heating-stove, a cooking-stove and a lamp. This was, of course, inconvenient and expensive. Suppose you want light. Very well, you may have it. But in order to have light you must sit in a slightly heated room even though it is midsummer. And what a lot of wood you will have to burn up if you light your house in this way!

People are always looking for something new and better. For many thousands of years they got along with the inconveniences of the open fire, never realizing that it was possible to separate light from heat, the lamp from the stove.

Later, when they wanted only light, they began to burn a piece of kindling wood instead of starting a fire on the hearth. This kindle-light gave less heat than the fireplace but it was still too hot.
It wasn't so simple a matter to separate light from heat. People worked at it for many hundreds of years and are still working at it. Our electric lamp, like the simple, primitive kindle-light gives out heat as well as light. True, an electric lamp doesn't heat the room to any great extent. But just put your hand on it and you will see that it is very hot.

Why is it that we have never succeeded in separating light from heat? The reason is very simple. We must have incandescence in order to get Light. In the electric lamp we heat up a carbon or metal filament, in a gas light a Welsbach mantle, in a kerosene or oil lamp particles of carbon in the flame.

But every incandescent thing, whether the filament in the electric lamp or an ordinary poker, gives off invisible heat rays as well as visible light rays. To get rid of the unnecessary heat rays we should have to have a veritable revolution in lighting: get our light in some other way than by incandescence.

But, you say, is there really any necessity for trying to get rid of these heat rays? The heat from an electric lamp is scarcely noticeable. It doesn't bother us in the least.

It isn't a question of our comfort or discomfort, but the fact that these heat rays, which are absolutely useless to us, cost too much. If our lamps did not give off any heat rays at all our light would be a hundred times cheaper than it is. Our electric stations would have to burn a hundred times less fuel.

Light costs us a tremendous amount not only because our lamps are poor but also because our present power-stations are very poorly constructed. In the steam boiler, in the steam-driven machinery, in the dynamos and in the wiring which carries the electric current a tremendous amount of precious energy is lost. A lamp gets only one fifth part of the energy which is generated in the fuel. And of this fifth only a hundredth part is actually delivered as light. That is, when we spend 500 dollars for coal we get only one dollar's worth of light.

The Best Lamp in the World

There is one lamp which gives off only light rays without any heat rays at all. I am sure you have seen this best-lamp-in-the-world many times in the grass on summer nights. It is the lantern of the glow-worm or firefly.

Isn't it amazing that the little glow-worm gives a light that is not only better than our best lamps but even better than the sun itself?

The sun gives off five times more heat than light rays, but the glow-worm gives off only light rays. Its light is cold. If it were hot, it would burn itself up.

And the glow-worm outdoes the sun in another respect too. Its light is far superior to sunlight. Sunlight, or the light of an electric lamp, seems to us to be a white light. But it is really made up of a mixture of different rays: violet, indigo, blue, green, yellow, orange and red.

Sometimes a sun ray is separated into its different light rays, refracted. You have all
seen how it is refracted when it goes through a prism or the edge of a mirror, throwing a multicolored bar of light on the wall. And the rainbow is also a ray of sunlight which has been broken up into its parts, refracted.

Now all rays are not equally good for the vision. Red light tires the eyes and seems dim to us. That is why no one works by a red light. The eye is much more sensitive to a green light. That is why shades on workers' lamps are usually made of green.

In incandescence we always get a lot of red rays. When we heated up our poker it first gave off a red light, one by one the other colors were added to it until it finally got white; that is, a mixture of all the colors.

The higher the temperature, the fewer there will be of the unpleasant dim red rays in comparison with the others. Therefore, to make a brighter and more agreeable light, inventors tried to raise the filament in the electric lamp or the Welsbach mantle in the gas lamp to as high a temperature as possible.

The light given by our present economical lightbulb is better than that of a lamp using a carbon filament because the metal filament can be raised to a higher temperature than the carbon. The carbon lamp gives a better light than the kerosene one, for the same reason. And so on down to the light of the red hot poker.

But even the economical electric light-bulb still gives off a lot of red rays. This is the reason it is injurious to the eyes to work for a long time by electric light.

To get rid of both the heat rays and the red light rays we must get rid of incandescence. The glowworm gives his light without the least heat. He gives off almost no red rays. That's why his light is so good. The future inventor must learn from this little glow-worm. If he succeeds in learning his secret, our light will be much better and cheaper than it is now.

Some progress has already been made along this line. They have succeeded in getting two substances from the body of the glow-worm; luciferine and luciferase, which begin to give off light when they are mixed. Who knows, perhaps in the future we shall be able to get larger and larger quantities of these substances, and then we shall no longer have lamps in our rooms. We shall have artificial glowworms instead.

**From Bonfire to Electric Light Bulb**

We have seen how it was not one single individual who worked alone on the invention of our evening lamp. It was many men, in different lands and different ages. You can easily see how impossible it would have been for one man alone to make so many experiments, changing first the fuel, then the construction of the lamp, then the method of obtaining light itself. This required the intelligent work of thousands of minds. One experiment led to another. One invention suggested another. And all together worked toward a common end. This end was to get a light which would be bright, inexpensive and good for the eyes.

The work began long, long ago. Scientists think that man learned how to start a fire fifty thousand years ago. Fifty thousand years ago these first attempts were made to
substitute fire for the sun; a way was found to produce light and heat artificially.

But the history of lighting does not really begin with the bonfire or the hearth fire, but with the "kindle-light", when man first tried to separate light from heat. The method of obtaining light was discovered--combustion. However, the question was to get some kind of combustion which would give a, bright and inexpensive light.

So they began to look about for a fuel. In a kindle-light made of pitchy wood the important thing was the pitch. So they discarded the wood and kept the pitch and the first pitch lamp was lighted. But this pitch burned badly. Then they tried burning tallow, and finally a vegetable oil. Oil does not burn so very well either, but they didn't have a better fuel yet. So they began to try to make a lamp which would make this poor fuel burn better. All kinds of complicated lamps were devised--lamps with pumps, with clock-works, with every kind of clever device.

That was as far as they could go. Yet still oil lamps burned unsatisfactorily. They guttered and smoked and went out two or three hours after they were lighted.

Again the search for a better fuel was begun. And they got gas, stearine and kerosene, all of which burn much better than oil or tallow. With these good fuels there was no need for such complicated lamps, so the lamps grew simpler. All those pumps and clock-works were discarded.

But the problem wasn't solved yet. Gas and kerosene both had their shortcomings. They were sooty, they vitiated the air and they were a fire risk. The whole trouble lay in the fact that in order to get light one had to make a fire.

The conquerors of light had a new task--to make a lamp without a flame. Now the flame was used for the purpose of heating. But an electric current could be used for heating as well as a flame. So the whole thing was begun again from the beginning.

A material suitable for being raised to a high degree of heat must be found. First they tried carbon. But carbon wouldn't stand being heated white hot. To get a bright white light they tried heating up metals which have a very high melting point: osmium, tantalum, tungsten.

It is clear that our electric lamp is not the final solution of the problem, which is to obtain light with a minimum loss of energy as heat.

This means we must get rid of high temperatures; get rid of the incandescent filament. We must get light without incandescence. And there are such lamps already in use.

These are long glass tubes filled with a very, rarefied gas. When an electric current is passed through the tube the gas begins to glow with a soft pleasant light. There is no filament here at all. It is the gas, not an incandescent filament which is giving off light. Nitrogen gives a golden light, oxygen a rose colored light, neon a red light. Letters and pictures for illuminations and advertising signs are made of these gas filled tubes.

At night the facades of buildings which in the daytime are most ordinary and uninteresting-looking are quite transformed; their glittering outlines stand out
against the night sky like jewelled palaces.

There are marvelous possibilities for the use of this kind of lighting. Houses of the future will be built not of stone and steel and glass only, but of light too. The Palace of the Soviets in Moscow will make use of this kind of lighting. It will sparkle at night with thousands of brilliant lights.

These glowing tubes will have other uses too. Besides lighting and beautifying cities they will be used as fiery signals to boats and aeroplanes; they will direct the courses of trains and automobiles. The red light of the neon tubes penetrates the thickest fogs.

The first light tubes were badly constructed, they used up too much energy. But they are being steadily improved. There are already some which consume less energy for the amount of light given off than do incandescent lamps. These tubes are filled with sodium vapor and give a lemon yellow light. Recently a sodium lamp has been made in the form of a bulb instead of a tube. This bulb closely resembles an electric light bulb. But the moment you look at it you notice that it has no filament.

A sodium light of 500 candle power uses no more energy than an incandescent light of 100 candle power.

The electric light made of this glowing gas threatens to become a serious competitor of the incandescent light. Such lights are already in use in many places in stores, libraries, hospitals and other public buildings.

In the Croydon aerodrome in England, long tubes are placed in a ditch surrounding the landing field. The ditch is covered with unbreakable glass and at night the landing field seems to be enclosed by strips of light.

Signs can be written on the ground in this way which would be visible to flying aeroplanes.

A hundred years from now it will be hard to recognize our dark, non-luminous planet. Already in America there are long "light corridors" for aeroplanes. In the future the whole earth will be covered with such roads and will shine, not with a reflected light, but with its own light like anew sun!

THE END

Children's Literature Texts
The Part played by Labour in the Transition from Ape to Man

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I

Labour is the source of all wealth, the political economists assert. And it really is the source – next to nature, which supplies it with the material that it converts into wealth. But it is even infinitely more than this. It is the prime basic condition for all human existence, and this to such an extent that, in a sense, we have to say that labour created man himself.

Many hundreds of thousands of years ago, during an epoch, not yet definitely determinable, of that period of the earth’s history known to geologists as the Tertiary period, most likely towards the end of it, a particularly highly-developed race of anthropoid apes lived somewhere in the tropical zone – probably on a great continent that has now sunk to the bottom of the Indian Ocean. [1] Darwin has given us an approximate description of these ancestors of ours. They were completely covered with hair, they had beards and pointed ears, and they lived in bands in the trees.

First, owing to their way of living which meant that the hands had different functions than the feet when climbing, these apes began to lose the habit of using their hands to walk and adopted a more and more erect posture. This was the decisive step in the transition from ape to man.

All extant anthropoid apes can stand erect and move about on their feet alone, but only in case of urgent need and in a very clumsy way. Their natural gait is in a half-erect posture and includes the use of the hands. The majority rest the knuckles of the fist on the ground and, with legs drawn up, swing the body through their long arms, much as a cripple moves on crutches. In general, all the transition stages from walking on all fours to walking on two legs are still to be observed among the apes today. The latter gait, however, has never become more than a makeshift for any of them.

It stands to reason that if erect gait among our hairy ancestors became first the rule and then, in time, a necessity, other diverse functions must, in the meantime, have devolved upon the hands. Already among the apes there is some difference in the way the hands and the feet are employed. In climbing, as mentioned above, the hands and feet have different uses. The hands are used mainly for gathering and holding food in the same way as the fore paws of the lower mammals are used. Many apes use their hands to build themselves nests in the trees or even to construct roofs between the branches to protect themselves against the weather, as the chimpanzee, for example, does. With their hands they grasp sticks to defend themselves against enemies, or bombard their enemies with fruits and stones. In captivity they use their hands for a number of simple operations copied from human beings. It is in this that one sees the great gulf between the undeveloped hand of even the most man-like apes and the human hand that has been highly perfected by hundreds of thousands of years of labour. The number and general arrangement of the bones and muscles are the same in both hands, but the hand of the lowest savage can perform hundreds of operations that no simian hand can imitate – no simian hand has ever fashioned even the crudest stone knife.

The first operations for which our ancestors gradually learned to adapt their hands during the many thousands of years of transition from ape to man could have been only very simple ones. The lowest savages, even those in whom regression to a more animal-like condition with a simultaneous physical degeneration can be assumed, are nevertheless far superior to these transitional beings. Before the first flint could be fashioned into a knife by human hands, a period of time probably elapsed in comparison with which the historical period known to us appears insignificant. But the decisive step had been taken, the hand had become free and could henceforth attain ever greater dexterity; the greater flexibility thus acquired was inherited and increased from generation to generation.
Thus the hand is not only the organ of labour, it is also the product of labour. Only by labour, by adaptation to ever new operations, through the inheritance of muscles, ligaments, and, over longer periods of time, bones that had undergone special development and the ever-renewed employment of this inherited finesse in new, more and more complicated operations, have given the human hand the high degree of perfection required to conjure into being the pictures of a Raphael, the statues of a Thorwaldsen, the music of a Paganini.

But the hand did not exist alone, it was only one member of an integral, highly complex organism. And what benefited the hand, benefited also the whole body it served; and this in two ways.

In the first place, the body benefited from the law of correlation of growth, as Darwin called it. This law states that the specialised forms of separate parts of an organic being are always bound up with certain forms of other parts that apparently have no connection with them. Thus all animals that have red blood cells without cell nuclei, and in which the head is attached to the first vertebra by means of a double articulation (condyles), also without exception possess lacteal glands for suckling their young. Similarly, cloven hoofs in mammals are regularly associated with the possession of a multiple stomach for rumination. Changes in certain forms involve changes in the form of other parts of the body, although we cannot explain the connection. Perfectly white cats with blue eyes are always, or almost always, deaf. The gradually increasing perfection of the human hand, and the commensurate adaptation of the feet for erect gait, have undoubtedly, by virtue of such correlation, reacted on other parts of the organism. However, this action has not as yet been sufficiently investigated for us to be able to do more here than to state the fact in general terms.

Much more important is the direct, demonstrable influence of the development of the hand on the rest of the organism. It has already been noted that our simian ancestors were gregarious; it is obviously impossible to seek the derivation of man, the most social of all animals, from non-gregarious immediate ancestors. Mastery over nature began with the development of the hand, with labour, and widened man’s horizon at every new advance. He was continually discovering new, hitherto unknown properties in natural objects. On the other hand, the development of labour necessarily helped to bring the members of society closer together by increasing cases of mutual support and joint activity, and by making clear the advantage of this joint activity to each individual. In short, men in the making arrived at the point where they had something to say to each other. Necessity created the organ; the undeveloped larynx of the ape was slowly but surely transformed by modulation to produce constantly more developed modulation, and the organs of the mouth gradually learned to pronounce one articulate sound after another.

Comparison with animals proves that this explanation of the origin of language from and in the process of labour is the only correct one. The little that even the most highly-developed animals need to communicate to each other does not require articulate speech. In its natural state, no animal feels handicapped by its inability to speak or to understand human speech. It is quite different when it has been tamed by man. The dog and the horse, by association with man, have developed such a good ear for articulate speech that they easily learn to understand any language within their range of concept. Moreover they have acquired the capacity for feelings such as affection for man, gratitude, etc., which were previously foreign to them. Anyone who has had much to do with such animals will hardly be able to escape the conviction that in many cases they now feel their inability to speak as a defect, although, unfortunately, it is one that can no longer be remedied because their vocal organs are too specialised in a definite direction. However, where vocal organs exist, within certain limits even this inability disappears. The buccal organs of birds are as different from those of man as they can be, yet birds are the only animals that can learn to speak; and it is the bird with the most hideous voice, the parrot, that speaks best of all. Let no one object that the parrot does not understand what it says. It is true that for the sheer pleasure of talking and associating with human beings, the parrot will chatter for hours at a stretch, continually repeating its whole vocabulary. But within the limits of its range of concepts it can also learn to understand what it is saying. Teach a parrot swear words in such a way that it gets an idea of their meaning (one of the great amusements of sailors returning from the tropics); tease it and you will soon discover that it knows how to use its
swear words just as correctly as a Berlin costermonger. The same is true of begging for titbits.

First labour, after it and then with it speech – these were the two most essential stimuli under the influence of which the brain of the ape gradually changed into that of man, which, for all its similarity is far larger and more perfect. Hand in hand with the development of the brain went the development of its most immediate instruments – the senses. Just as the gradual development of speech is inevitably accompanied by a corresponding refinement of the organ of hearing, so the development of the brain as a whole is accompanied by a refinement of all the senses. The eagle sees much farther than man, but the human eye discerns considerably more in things than does the eye of the eagle. The dog has a far keener sense of smell than man, but it does not distinguish a hundredth part of the odours that for man are definite signs denoting different things. And the sense of touch, which the ape hardly possesses in its crudest initial form, has been developed only side by side with the development of the human hand itself, through the medium of labour.

The reaction on labour and speech of the development of the brain and its attendant senses, of the increasing clarity of consciousness, power of abstraction and of conclusion, gave both labour and speech an ever-renewed impulse to further development. This development did not reach its conclusion when man finally became distinct from the ape, but on the whole made further powerful progress, its degree and direction varying among different peoples and at different times, and here and there even being interrupted by local or temporary regression. This further development has been strongly urged forward, on the one hand, and guided along more definite directions, on the other, by a new element which came into play with the appearance of fully-fledged man, namely, society.

Hundreds of thousands of years – of no greater significance in the history of the earth than one second in the life of man [Engels note: A leading authority in this respect, Sir William Thomson, has calculated that little more than a hundred million years could have elapsed since the time when the earth had cooled sufficiently for plants and animals to be able to live on it.] – certainly elapsed before human society arose out of a troupe of tree-climbing monkeys. Yet it did finally appear. And what do we find once more as the characteristic difference between the troupe of monkeys and human society? Labour. The ape herd was satisfied to browse over the feeding area determined for it by geographical conditions or the resistance of neighbouring herds; it undertook migrations and struggles to win new feeding grounds, but it was incapable of extracting from them more than they offered in their natural state, except that it unconsciously fertilised the soil with its own excrement. As soon as all possible feeding grounds were occupied, there could be no further increase in the ape population; the number of animals could at best remain stationary. But all animals waste a great deal of food, and, in addition, destroy in the germ the next generation of the food supply. Unlike the hunter, the wolf does not spare the doe which would provide it with the young the next year; the goats in Greece, that eat away the young bushes before they grow to maturity, have eaten bare all the mountains of the country. This “predatory economy” of animals plays an important part in the gradual transformation of species by forcing them to adapt themselves to other than the usual food, thanks to which their blood acquires a different chemical composition and the whole physical constitution gradually alters, while species that have remained unadapted die out. There is no doubt that this predatory economy contributed powerfully to the transition of our ancestors from ape to man. In a race of apes that far surpassed all others in intelligence and adaptability, this predatory economy must have led to a continual increase in the number of plants used for food and the consumption of more and more edible parts of food plants. In short, food became more and more varied, as did also the substances entering the body with it, substances that were the chemical premises for the transition to man.

But all that was not yet labour in the proper sense of the word. Labour begins with the making of tools. And what are the most ancient tools that we find – the most ancient judging by the heirlooms of prehistoric man that have been discovered, and by the mode of life of the earliest historical peoples and of the rawest of contemporary savages? They are hunting and fishing implements, the former at the same time serving as weapons. But hunting and fishing presuppose the transition from
an exclusively vegetable diet to the concomitant use of meat, and this is another important step in the process of transition from ape to man. A meat diet contained in an almost ready state the most essential ingredients required by the organism for its metabolism. By shortening the time required for digestion, it also shortened the other vegetative bodily processes that correspond to those of plant life, and thus gained further time, material and desire for the active manifestation of animal life proper. And the farther man in the making moved from the vegetable kingdom the higher he rose above the animal. Just as becoming accustomed to a vegetable diet side by side with meat converted wild cats and dogs into the servants of man, so also adaptation to a meat diet, side by side with a vegetable diet, greatly contributed towards giving bodily strength and independence to man in the making. The meat diet, however, had its greatest effect on the brain, which now received a far richer flow of the materials necessary for its nourishment and development, and which, therefore, could develop more rapidly and perfectly from generation to generation. With all due respect to the vegetarians man did not come into existence without a meat diet, and if the latter, among all peoples known to us, has led to cannibalism at some time or other (the forefathers of the Berliners, the Weletabians or Wilzians, used to eat their parents as late as the tenth century), that is of no consequence to us today.

The meat diet led to two new advances of decisive importance – the harnessing of fire and the domestication of animals. The first still further shortened the digestive process, as it provided the mouth with food already, as it were, half-digested; the second made meat more copious by opening up a new, more regular source of supply in addition to hunting, and moreover provided, in milk and its products, a new article of food at least as valuable as meat in its composition. Thus both these advances were, in themselves, new means for the emancipation of man. It would lead us too far afield to dwell here in detail on their indirect effects notwithstanding the great importance they have had for the development of man and society.

Just as man learned to consume everything edible, he also learned to live in any climate. He spread over the whole of the habitable world, being the only animal fully able to do so of its own accord. The other animals that have become accustomed to all climates – domestic animals and vermin – did not become so independently, but only in the wake of man. And the transition from the uniformly hot climate of the original home of man to colder regions, where the year was divided into summer and winter, created new requirements – shelter and clothing as protection against cold and damp, and hence new spheres of labour, new forms of activity, which further and further separated man from the animal.

By the combined functioning of hand, speech organs and brain, not only in each individual but also in society, men became capable of executing more and more complicated operations, and were able to set themselves, and achieve, higher and higher aims. The work of each generation itself became different, more perfect and more diversified. Agriculture was added to hunting and cattle raising; then came spinning, weaving, metalworking, pottery and navigation. Along with trade and industry, art and science finally appeared. Tribes developed into nations and states. Law and politics arose, and with them that fantastic reflection of human things in the human mind – religion. In the face of all these images, which appeared in the first place to be products of the mind and seemed to dominate human societies, the more modest productions of the working hand retreated into the background, the more so since the mind that planned the labour was able, at a very early stage in the development of society (for example, already in the primitive family), to have the labour that had been planned carried out by other hands than its own. All merit for the swift advance of civilisation was ascribed to the mind, to the development and activity of the brain. Men became accustomed to explain their actions as arising out of thought instead of their needs (which in any case are reflected and perceived in the mind); and so in the course of time there emerged that idealistic world outlook which, especially since the fall of the world of antiquity, has dominated men’s minds. It still rules them to such a degree that even the most materialistic natural scientists of the Darwinian school are still unable to form any clear idea of the origin of man, because under this ideological influence they do not recognise the part that has been played therein by labour.
Animals, as has already been pointed out, change the environment by their activities in the same way, even if not to the same extent, as man does, and these changes, as we have seen, in turn react upon and change those who made them. In nature nothing takes place in isolation. Everything affects and is affected by every other thing, and it is mostly because this manifold motion and interaction is forgotten that our natural scientists are prevented from gaining a clear insight into the simplest things. We have seen how goats have prevented the regeneration of forests in Greece; on the island of St. Helena, goats and pigs brought by the first arrivals have succeeded in exterminating its old vegetation almost completely, and so have prepared the ground for the spreading of plants brought by later sailors and colonists. But animals exert a lasting effect on their environment unintentionally and, as far as the animals themselves are concerned, accidentally. The further removed men are from animals, however, the more their effect on nature assumes the character of premeditated, planned action directed towards definite preconceived ends. The animal destroys the vegetation of a locality without realising what it is doing. Man destroys it in order to sow field crops on the soil thus released, or to plant trees or vines which he knows will yield many times the amount planted. He transfers useful plants and domestic animals from one country to another and thus changes the flora and fauna of whole continents. More than this. Through artificial breeding both plants and animals are so changed by the hand of man that they become unrecognisable. The wild plants from which our grain varieties originated are still being sought in vain. There is still some dispute about the wild animals from which our very different breeds of dogs or our equally numerous breeds of horses are descended.

It goes without saying that it would not occur to us to dispute the ability of animals to act in a planned, premeditated fashion. On the contrary, a planned mode of action exists in embryo wherever protoplasm, living albumen, exists and reacts, that is, carries out definite, even if extremely simple, movements as a result of definite external stimuli. Such reaction takes place even where there is yet no cell at all, far less a nerve cell. There is something of the planned action in the way insect-eating plants capture their prey, although they do it quite unconsciously. In animals the capacity for conscious, planned action is proportional to the development of the nervous system, and among mammals it attains a fairly high level. While fox-hunting in England one can daily observe how unerringly the fox makes use of its excellent knowledge of the locality in order to elude its pursuers, and how well it knows and turns to account all favourable features of the ground that cause the scent to be lost. Among our domestic animals, more highly developed thanks to association with man, one can constantly observe acts of cunning on exactly the same level as those of children. For, just as the development history of the human embryo in the mother’s womb is only an abbreviated repetition of the history, extending over millions of years, of the bodily development of our animal ancestors, starting from the worm, so the mental development of the human child is only a still more abbreviated repetition of the intellectual development of these same ancestors, at least of the later ones. But all the planned action of all animals has never succeeded in impressing the stamp of their will upon the earth. That was left for man.

In short, the animal merely uses its environment, and brings about changes in it simply by its presence; man by his changes makes it serve his ends, masters it. This is the final, essential distinction between man and other animals, and once again it is labour that brings about this distinction.

Let us not, however, flatter ourselves overmuch on account of our human victories over nature. For each such victory nature takes its revenge on us. Each victory, it is true, in the first place brings about the results we expected, but in the second and third places it has quite different, unforeseen effects which only too often cancel the first. The people who, in Mesopotamia, Greece, Asia Minor and elsewhere, destroyed the forests to obtain cultivable land, never dreamed that by removing along with the forests the collecting centres and reservoirs of moisture they were laying the basis for the present forlorn state of those countries. When the Italians of the Alps used up the pine forests on the southern slopes, so carefully cherished on the northern slopes, they had no inkling that by doing so they were cutting at the roots of the dairy industry in their region; they had still less inkling that
they were thereby depriving their mountain springs of water for the greater part of the year, and making it possible for them to pour still more furious torrents on the plains during the rainy seasons. Those who spread the potato in Europe were not aware that with these farinaceous tubers they were at the same time spreading scrofula. Thus at every step we are reminded that we by no means rule over nature like a conqueror over a foreign people, like someone standing outside nature – but that we, with flesh, blood and brain, belong to nature, and exist in its midst, and that all our mastery of it consists in the fact that we have the advantage over all other creatures of being able to learn its laws and apply them correctly.

And, in fact, with every day that passes we are acquiring a better understanding of these laws and getting to perceive both the more immediate and the more remote consequences of our interference with the traditional course of nature. In particular, after the mighty advances made by the natural sciences in the present century, we are more than ever in a position to realise, and hence to control, also the more remote natural consequences of at least our day-to-day production activities. But the more this progresses the more will men not only feel but also know their oneness with nature, and the more impossible will become the senseless and unnatural idea of a contrast between mind and matter, man and nature, soul and body, such as arose after the decline of classical antiquity in Europe and obtained its highest elaboration in Christianity.

It required the labour of thousands of years for us to learn a little of how to calculate the more remote natural effects of our actions in the field of production, but it has been still more difficult in regard to the more remote social effects of these actions. We mentioned the potato and the resulting spread of scrofula. But what is scrofula compared to the effects which the reduction of the workers to a potato diet had on the living conditions of the popular masses in whole countries, or compared to the famine the potato blight brought to Ireland in 1847, which consigned to the grave a million Irishmen, nourished solely or almost exclusively on potatoes, and forced the emigration overseas of two million more? When the Arabs learned to distil spirits, it never entered their heads that by so doing they were creating one of the chief weapons for the annihilation of the aborigines of the then still undiscovered American continent. And when afterwards Columbus discovered this America, he did not know that by doing so he was giving a new lease of life to slavery, which in Europe had long ago been done away with, and laying the basis for the Negro slave trade. The men who in the seventeenth and eighteenth centuries laboured to create the steam-engine had no idea that they were preparing the instrument which more than any other was to revolutionise social relations throughout the world. Especially in Europe, by concentrating wealth in the hands of a minority and disposesssing the huge majority, this instrument was destined at first to give social and political domination to the bourgeoisie, but later, to give rise to a class struggle between bourgeoisie and proletariat which can end only in the overthrow of the bourgeoisie and the abolition of all class antagonisms. But in this sphere too, by long and often cruel experience and by collecting and analysing historical material, we are gradually learning to get a clear view of the indirect, more remote social effects of our production activity, and so are afforded an opportunity to control and regulate these effects as well.

This regulation, however, requires something more than mere knowledge. It requires a complete revolution in our hitherto existing mode of production, and simultaneously a revolution in our whole contemporary social order.

All hitherto existing modes of production have aimed merely at achieving the most immediately and directly useful effect of labour. The further consequences, which appear only later and become effective through gradual repetition and accumulation, were totally neglected. The original common ownership of land corresponded, on the one hand, to a level of development of human beings in which their horizon was restricted in general to what lay immediately available, and presupposed, on the other hand, a certain superfluity of land that would allow some latitude for correcting the possible bad results of this primeval type of economy. When this surplus land was exhausted, common ownership also declined. All higher forms of production, however, led to the division of the population into different classes and thereby to the antagonism of ruling and oppressed classes.
Thus the interests of the ruling class became the driving factor of production, since production was no longer restricted to providing the barest means of subsistence for the oppressed people. This has been put into effect most completely in the capitalist mode of production prevailing today in Western Europe. The individual capitalists, who dominate production and exchange, are able to concern themselves only with the most immediate useful effect of their actions. Indeed, even this useful effect – inasmuch as it is a question of the usefulness of the article that is produced or exchanged – retreats far into the background, and the sole incentive becomes the profit to be made on selling.

Classical political economy, the social science of the bourgeoisie, in the main examines only social effects of human actions in the fields of production and exchange that are actually intended. This fully corresponds to the social organisation of which it is the theoretical expression. As individual capitalists are engaged in production and exchange for the sake of the immediate profit, only the nearest, most immediate results must first be taken into account. As long as the individual manufacturer or merchant sells a manufactured or purchased commodity with the usual coveted profit, he is satisfied and does not concern himself with what afterwards becomes of the commodity and its purchasers. The same thing applies to the natural effects of the same actions. What cared the Spanish planters in Cuba, who burned down forests on the slopes of the mountains and obtained from the ashes sufficient fertiliser for one generation of very highly profitable coffee trees – what cared they that the heavy tropical rainfall afterwards washed away the unprotected upper stratum of the soil, leaving behind only bare rock! In relation to nature, as to society, the present mode of production is predominantly concerned only about the immediate, the most tangible result; and then surprise is expressed that the more remote effects of actions directed to this end turn out to be quite different, are mostly quite the opposite in character; that the harmony of supply and demand is transformed into the very reverse opposite, as shown by the course of each ten years’ industrial cycle – even Germany has had a little preliminary experience of it in the “crash”; that private ownership based on one’s own labour must of necessity develop into the expropriation of the workers, while all wealth becomes more and more concentrated in the hands of non-workers; that [... the manuscript breaks off here.]

Notes

1. In the 1870s, when this was written, British zoogeographer Philip Lutley Selater put forth the theory that a continent (he called "Lemuria") existed which reached from modern Madagascar to India and Sumatra – and this continent has since submerged beneath the Indian Ocean.
Karl Kautsky

Ethics and the Materialist Conception Of History

Chapter IV
The Ethic of Darwinism

I. The Struggle for Existence
Kant, like Plato, had divided mankind into two parts, a natural and a supernatural, an animal and an
angelic. But the strong desire to bring the entire world, including our intellectual functions, under a unitary conception, and to exclude all factors besides the natural from it, or in other words the materialist method of thought, was too deeply grounded in the circumstances for Kant to be able to paralyze it for any length of time. And the splendid progress made by the natural sciences, which began just at the very time of Kant’s death to make a spurt forwards, brought a series of new discoveries, which more and more filled up the gap between man and the rest of nature, and among other things revealed the fact that the apparently angelic in man was also to be seen in the animal world, and thus was of animal nature.

All the same the Materialist Ethics of the nineteenth century, so far as it was dominated by the conceptions of natural science, equally in the bold and outspoken form which it took in Germany, as well as in the more retiring and modest English, and even now French version, did not get beyond that which the eighteenth century had taught. Thus Feuerbach founded morality on the desire for happiness, Auguste Comte, the founder of Positivism, took on the other hand from the English the distinction between moral or altruistic feelings, and the egoistical, both of which are equally rooted in human nature.

A great and decided advance over this position was first made by Darwin, who proved in his book on the Descent of Man, that the altruistic feelings formed no peculiarity of man, that they are also to be found in the animal world, and that there, as here, they spring from similar causes, which are in essence identical and which have called forth and developed all the faculties of beings endowed with the power of moving themselves. With that almost the last barrier between man and animal was torn down. Darwin did not follow up his discoveries any further, and yet they belong to the greatest and most fruitful of the human intellect, and enable us to develop a new critique of knowledge.

When we study the organic world, it shows to us, in contrast to the inorganic, one very striking peculiarity: We find in it adaptation to end. All organized beings are constructed and endowed more or less with a view to an end. The end which they serve is nevertheless not one which lies outside of them. The world as a whole has no aim. The aim lies in the individuals themselves, its parts are so arranged and fitted out, that they serve the individual, the whole. Purpose and division of labor arise together. The essence of the organism is the division of labor just as much as adaptation to end. One is the condition of the other.

The division of labor distinguishes the organism from inorganic individuals, for example, crystals. Even crystals are distinct individuals with a distinct form. They grow, when they find the necessary material for their formation under the requisite conditions, but they are through and through symmetrical. On the other hand the lowest organism is a vesicle much less visible and less complicated than a crystal, but a vesicle whose external side is different, and has different functions to the inner.

That the division of labor is one which is suitable for the purpose, that is, one which is useful to the individual, renders his existence possible, or even ameliorates it, seems wonderful. But it would be still more wonderful if individuals maintained themselves and procreated with a division of labor which was not suitable for the purpose, which rendered their existence difficult or even impossible.

But what is the work which the organs of the organism have to accomplish? This work is the struggle for life, that is, not the struggle with other organisms of the same kind, as the word is occasionally used, but the fight with the whole of nature. Nature is in continual movement and is always changing her forms, hence only such individuals will he able to maintain their form for any period of time in this eternal change who are in a position to develop particular organs against those external influences which threaten the existence of the individual as well as to supply the place of those parts which it is obliged to give up continually to the external world. Quickest and best will those individuals and groups assert themselves, whose weapons of defence and instruments for obtaining food are the best adapted to their end, that is best adapted to the external world, to avoid its dangers and to capture the sources of food. The uninterrupted process of adaptation, and the
selection of the fittest, by means of the struggle for existence produce, under such circumstances as
usually form themselves on the earth since it has bourne organized beings, an increasing division of
labor. In fact the more developed the division of labor is in a society, the more advanced does that
society appear to us. The continual process of rendering the organic world more perfect is thus the
result of the struggle for existence in it – and that probably for a long time to come will be its future
result, that is as long as the conditions of our planet do not essentially alter. Certainly we have no
right to look on this process as a necessary law for all time. That would amount to imputing to the
world an end which is not to be found in it.

The development need not always proceed at the same rate. From time to time periods can come,
when the various organisms, each in its way, arrive at the highest possible degree of adaptation to
the existing conditions, that is, are in the most complete harmony with their surroundings. So long
as these conditions endure they will develop no farther, but the form which has been arrived at will
develop into a fixed type, which procreates itself unchanged. A further development will only then
occur when the surroundings undergo a considerable alteration, when the inorganic nature is subject
to changes which disturb the balance of the organic. Such changes, however, take place from time
to time, either single, sudden and violent, or numerous and unnoticed, the sum total and effect of
which, however, equally brings on new situations, as for example alterations in the ocean currents,
in the surface of the earth, perhaps even in the position of the planet in the universe, which bring
about climatic changes, transform thick forests into deserts of sand, cover tropical landscapes with
icebergs and vice versa. These alterations render new adaptations to the changed conditions
necessary, they produce migrations which likewise bring the organisms into new surroundings, and
produce fresh struggles for life between the old inhabitants and the new incomers, exterminate the
badly adapted and the unadaptable individuals and types, and create new divisions of labor, new
functions and new organs or transform the old. It is not always the highest developed organisms
which best assert themselves by this new adaptation. Every division of labor implies a certain one-
sidedness. Highly developed organs, which are specially adapted for a particular method of life, are
for another far less useful than organs which are less developed, and in that particular method of life
less effective, but more many-sided and more easily adaptable. Thus we see often higher developed
kinds of animals and plants die out, and lower kinds take over the farther development of new
higher organisms. Probably man is not sprung from the highest type of apes, the man apes, which
are tending to die out, but from a lower species of four-handed animals.

II. Self-Movement and Intelligence

At an early period the organisms divided themselves into two great groups – those which developed
the organs of self motion, and those which lacked it, animals and plants.

It is clear that the power of self movement is a mighty weapon in the struggle for life. It enables it to
follow its food, to avoid danger, to bring its young into places where they will be best secured from
dangers and which are best provided with food.

Self motion, however, necessarily implies an intelligence, and vice versa. The one of these factors
without the other is absolutely useless. Only in combination do they become a weapon in the
struggle for life. The power of self-movement is completely useless, when it is not combined with a
power to recognize the world in which I have to move myself. What use would the legs be to the
stag, if he had not the power to recognize his enemies and his food grounds? On the other hand, for
a plant intelligence of any kind would be useless. Were the blade of grass able to see, hear or smell
the approaching cow, that would not in the least help it to avoid being eaten. Self-movement and
intelligence thus necessarily go together, one without the other is useless. Wherever these faculties
may spring from, they invariably come up together and develop themselves jointly. There is no self-
movement without intelligence, and no intelligence without self-movement. And together they serve
the same ends, the securing and alleviation of the individual existence.
As a means to that they and their organs are developed and perfected by the struggle for life, but only as a means thereto. Even the most highly developed intelligence has no capacities which would not be of use as weapons in the struggle for existence. Thus is explained the one-sidedness and the peculiarity of our intelligence.

To recognize things in themselves may appear to many philosophers an important task; for our existence it is highly indifferent, whatever we have to understand by the thing in itself. On the other hand for every being endowed with power of movement it is of the greatest importance to rightly distinguish the things and to recognize their relations to one another. The sharper his intelligence in this respect the better service will it do him. For the existence of the singing bird it is quite indifferent what those things may be in themselves which appear to it as a berry, a hawk, or a thunder cloud. But indispensable is it for his existence to distinguish exactly berries, hawks, and clouds from the other things among his surroundings, since that alone puts him in a position to end his food, to escape the enemy, and to reach shelter in time. It is thus inevitable that the intelligence of the animal should be a power of distinguishing in space.

But just as indispensable is it to recognize the sequence of the things in time, and indeed their necessary sequence as cause and effect. Since the movement as cause can only bring as a universal result the maintenance of existence, if it aims at special more immediate or remoter effects which are so much the more easily to be achieved, the better the individual has got to learn these effects with their causes. To repeat the above example of a bird, it is not sufficient that it should know how to distinguish berries, hawks, and thunder clouds from the other things in space, it must also know that the enjoyment of the berries has the effect of satisfying its hunger, that the appearance of the hawk will have the effect that the first small bird which it can grasp will serve it as food, and that the rising thunder clouds produce storm, rain, and hail as results.

Even the lowest animal, so soon as it possesses a trace of ability to distinguish and self movement, develops a suspicion of causality. If the earth shakes, that is a sign for the worm that danger threatens and an incentive to flight.

Thus if the intelligence is to be of use to the animal in its movements it must be organized so that it is in a position to show him the distinctions in time and space as well as the causal connections.

But it must do even more. All the parts of the body serve only one individual, only one end, the maintenance of the individual. The division of labor must never go so far that the individual parts become independent, because that would lead to the dismemberment of the individual. They will work so much the more efficiently, the tighter the parts are held together, and the more uniform the word of command. From this follows the necessary unity of the consciousness. If every part of the body had its own intellectual organs, or did each of the senses which conveys to us a knowledge of the outer world produce its own consciousness, then would all knowledge of the world in such a case and the cooperation of the various members of the body be much impeded, the advantages of the division of labor would be abolished, or changed into disadvantages, the support which the senses or the organs of movement mutually give to each other would cease and there would come instead mutual hindrance.

Finally, however, the intelligence must possess in addition the power to gather experiences and to compare. To return once more to our singing bird, he has two ways open to him to find out what food is the best for him and where it is easiest to be found; what enemies are dangerous for him and how to escape them. One, his own experience, the other the observation of other and older birds, who have already made experience. No master is, as is well known, born. Every individual can so much the easier maintain himself in the struggle for life, the greater his experience and the better arranged they are; to that, however, belongs the gift of memory and the capacity to compare former impression with later, and to extract from the common and universal element, to separate the essential from the unessential, that is: to think. Does observation communicate to us the differences, the particular factor through the senses, so does thinking tell us the common factor, the universal element in the things.
“The universal,” says Dietzgen, “is the content of all concepts, of all knowledge, of all science, of all acts of thought. Therewith the analysis of the organ of thought exhibits the latter, as the power to investigate the universal in the particular.”

All these dualities of the intellectual powers, we find developed in the animal world, even if not in so high a degree as in men, and they are often for us difficult to recognize, since it is not always easy to distinguish conscious actions springing from intelligence, from the involuntary and unconscious actions, simple reflex actions and instinctive movements which even in men play a great role.

If we find all these qualities of the intellectual faculties to be a necessary concomitant of the power of self movement already in the animal world, so do we, on the other hand, find in the same qualities also the same limitations which even the most embracing and most penetrating understanding of the highly developed civilized man cannot surmount.

Forces and capacities which were acquired as weapons in the battle for existence can naturally be made available for other purposes as well, besides those of rendering existence secure, when the organism has brought its power of self movement and its intelligence, as well as its instincts of which we will soon speak, to a high enough degree of development. The individual can employ the muscles, which were developed in it for the purpose of snatching its booty, or warding off the foe, as well for dancing and playing. But their particular character is obtained by these powers and capacities all the same, only from the struggle for life which developed them. Play and dance develop no particular muscles.

That holds good also of the intellectual powers and faculties. Each was developed as a necessary supplement to the power of self-movement in the struggle for life, in order to render possible to the organism the most suitable movement in the surrounding world for its own preservation, yet it could all the same be made to serve other purposes. To these belong also pure knowing without any practical thoughts in the background, without regard for the practical consequences which it can bring about. But our intellectual powers have not been developed by the struggle for existence, to become an organ of pure knowledge, but only to be an organ which regulates our movements in conformity with their purpose. The more completely it functions in respect of the latter, the more incomplete is it in the first. From the very beginning most intimately connected with the power of self movement, it develops itself completely only in mutual dependence on the power of self movement and can only be brought to perfection in this connection. Also the power of the human faculties of cognition and human knowledge is most intimately bound up with human practice, as we shall see.

It is the practice, however, which guarantees to us the certainty of our knowledge.

So soon as my knowledge enables me to bring about distinct effects, the production of which lies in my power, the relation of cause and effect ceases for me to be simply chance or simple appearance, or simple forms of knowledge, as the pure contemplation and thought might well describe them. The knowledge of this relation becomes, through the practice, a knowledge of something real and is raised to certain knowledge.

The boundaries of practice witness certainly to the boundaries of our certain knowledge.

That theory and practice are dependent on one another and only through the mutual permeation of the one by the other can at any time the highest result attainable be arrived at, is only an outcome of the fact that movement and intellectual powers, from their earliest beginnings, were bound to go together. In the course of the development of human society the division of labor has brought it about that the natural unity of these two factors would be destroyed, and created classes to whom principally the movement, and others to whom principally the knowing, fell. We have already pointed out how this was reflected in philosophy, through the creation of two worlds, a higher or intellectual and a lower or bodily.
But wholly were the two functions naturally in no individual to be divided, and the proletariat movement of today is directing its energies with good effect to abolishing this distinction and with it also the dualist philosophy, the philosophy of pure knowledge. Even the deepest, most abstract knowledge, which apparently is farthest removed from the practical, influence this, and are influenced by it, anti to bring in us this influence to consciousness becomes the duty of a critique of human knowledge. As before, knowledge remains in the last resort always a weapon in the struggle for existence, a means to give to our movements, be they movements in nature or society, the most suitable forms and directions.

“Philosophers have only interpreted the world differently,” said Marx. “The great thing, however, is to change it.”

**III. The Motives of Self Maintenance and Propagation**

Both powers of self movement and of knowing belong inseparably together as weapons in the struggle for existence. The one developed itself along with the other, and in the degree in which these weapons win in importance in the organism, do the other more primitive ones, which are less necessary, as for example, that of fruitfulness and of vitality diminish. On the other hand, to the degree that these diminish must the importance of the first named factors for the struggle for life increase, and it must call forth their greater development.

But self movement and knowledge form by themselves by no means a sufficient weapon in the struggle. Of what use is merely the strongest muscles, the most agile joints, the sharpest senses, the greatest understanding, in this struggle, if I do not feel in me the impulse to employ them to my preservation – if the sight of food or the knowledge of danger leaves me indifferent and awakes no emotion in me? Self movement and intellectual capacity first, then, become weapons in the struggle for existence, if with them there arises a longing for the self preservation of the organism, which brings it about that all knowledge which is of importance for its existence at once produces the will to carry out the movement necessary for its existence, and therewith calls forth this movement.

Self movement and intellectual powers are without importance for the existence of the individual without his instinct of self preservation, just as this latter again is of no importance with both the former factors. All three are most intimately bound up with each other. The instinct of self preservation is the most primitive of the animal instincts and the most indispensable. Without it no animal species endowed in any degree with the power of self movement and a faculty of intelligence could maintain itself even a short time. It rules the entire life of the animal. The same social development, which ascribes the care of the intellectual faculties to particular classes, and the practical movement to others, and produces in the first an elevation of the “spirit” over the gross “matter”, goes so far in the process of isolating the intellectual faculties, that the latter, out of contempt for the “mechanical” practice which serves for the maintenance of life, comes to despise life itself. But this kind of knowledge has never as yet been able to overcome the instinct of self preservation, and to paralyze the “practise” which serves for the maintenance of life. Although many a suicide be philosophically grounded, we always, in every practical act of the denial of life, finally meet with disease or desperate social circumstances as the cause, but not a philosophical theory. Mere philosophizing cannot overcome the instinct of self preservation.

But if this is the most primitive and widely spread of all instincts it is still not the only one. It serves only for the maintenance of the individual. However long this may endure, finally it disappears without leaving any trace of its individuality behind, if it has not reproduced itself. Only those species of organisms will assert themselves in the struggle for existence, who leave a progeny behind them.

Now with the plants and the lower animals reproduction is a process which demands no power of self movement and no faculty of intelligence. That changes, however, with the animals so soon as
reproduction becomes a sexual act, in which two individuals are concerned, who have to unite in order to lay either eggs and seeds (sperm) on the same spot outside of the body, or to incorporate the sperm in the body of the individual carrying the eggs. That demands a will, an impulse to find each other, to unite. Without that can the non-sexual propagation not take place, the stronger it is in the periods favorable for reproduction, so much the sooner will it take place, so much the better will be the prospects of a progeny, for the maintenance of the species. On the other hand these prospects are bad for individuals and species in whom the impulse for self-reproduction is weakly developed. From a given degree of the development consequently natural selection must develop through the struggle for life an outspoken impulse to reproduction in the animal world and ever more strengthen it.

But it does not always suffice to the attainment of a numerous progeny. We have seen that in the degree in which self movement and intellectual powers grow, the number of the germs, which the individual produces, as well as its vitality, have a tendency to diminish. On the other hand the greater the division of labor, the more complicated the organism, the longer the period which is requisite for its development and its attainment to maturity. Even if a part of this period is laid in the maternal body, that has its limits. Even from considerations of space is this body not in a position to bear an organism as big as itself. It must expel the young long before that period is arrived at. From the young animals, however, the capacities for self movement and intelligence are the latest achieved, and they are mostly very weakly developed as they leave the protecting cover of the egg or the maternal body. The egg expelled by the mother is completely without motion and intelligence. Then the care for the progeny becomes an important function of the mother: the hiding and defence of the eggs anti of the young, the feeding of the latter, etc. As the impulse for reproduction, so is it with the love for the young, especially in the animal world is the maternal love developed as an indispensable means, from a certain stage of the development on, to secure the perpetuation of the species. With the impulse towards individual self preservation these impulses have nothing to do: they often come into conflict with it, and they can be so strong that they overcome it. It is clear that under otherwise equal conditions, those individuals and species have the best prospect of reproducing themselves and handing on their qualities and impulses in whom the impulse of self maintenance is not able to diminish the impulse to reproduce and protect the progeny.

IV. The Social Instinct

Besides these instincts which are peculiar to the higher animals, the struggle for life develops in particular kinds of animals still others, which are special and conditioned by the peculiarity of their method of life, for example, the migratory instinct, which we will not farther study. Here we are interested in another kind of instinct which is of very great importance for our subject: the social instinct.

The cooperation of similar organisms in larger crowds is a phenomenon which we can discover quite in their earliest stages: the microbes. It is explained alone by the simple fact of reproduction. If the organisms have no self movement, the progeny will consequently gather round the producer, if they are not by any chance borne away by the movements of the external world, water currents, winds, and phenomena of that sort. The apple falls, as is well known, not far from the stem, and when it is not eaten, and falls on fruitful soil, there grow from the pips young trees, which keep the old tree company. But even in animals with power of self-movement it is very natural that the young should remain with the old, if no external circumstances supply a ground for them to remove themselves. The living together of individuals of the same species, the most primitive form of social life, is also the most primitive forms of life itself. The division of organisms, which have a common origin, is a later act.

The separation can be brought about by the most diverse causes. The most obvious, and certainly
the most effective, is the lack of sustenance. Each locality can only yield a certain quantity of food. If a certain species of animals multiplies beyond the limits of their food supply, the superfluous ones must either emigrate or starve. Above a certain number the numbers of organisms living in one place can not go.

But there are certain species of animals, for whom the isolation, the division in individual pairs, who live only for themselves, for whom such a life affords an advantage in the struggle for existence. Thus, for example, for the cat species, which lie in wait for their booty and take it with an unexpected spring. This method of acquiring their sustenance would be made more difficult, if not impossible, if they circulated in herds. The first spring on the booty would drive all the game away for all the others. For wolves which do not come unexpectedly on their prey, but worry it to death, the foregathering in herds affords an advantage; one hunts the game to the other, which blocks for it the way. The cat nevertheless hunts more successfully alone.

On the other hand again there are animals who choose isolation because in this fashion they are less conspicuous and can easiest hide themselves, soonest escape the foe. The traps set by man have, for example, had the effect that many animals which formerly lived in societies, are now only to be found isolated, such as the beavers in Europe. That is the only way for them to remain unnoticed.

On the other hand, however, there are numerous animals which draw advantage from their social life. They are seldom beasts of prey. We have mentioned the wolf above. But even they only hunt in bands when food is scarce, in winter. In summer when it is easier to get, they live in pairs. The nature of the beast of prey is always inclined to fighting and violence, and consequently does not agree well with its equals.

The herbivora are more peaceful from the very manner in which they obtain their food. That very fact of itself renders it easier for them to herd together, or to remain together, because they are more defenceless, they win, however, through their greater numbers, new weapons in the struggle for life. The union of many weak forces in common action can produce a new and greater force. Then through union the greater strength of certain individuals is used for the good of all. When the stronger ones fight now for themselves, they fight for the good of the weaker, when the more experienced look out for their own safety, find out for themselves feeding grounds, they do it also for the inexperienced. Now it becomes possible to introduce a division of labor among the united individuals, fleeting though it be, yet it increases their strength and their safety. It is impossible to watch the neighborhood with the most complete attention and at the same time to feed peacefully. Naturally during sleep all observation of all kind comes to an end. But in society one watcher suffices to render the others safe during sleep or while eating.

Through the division of labors the union of individuals becomes a body with different organs to cooperate to a given end, and this end is the maintenance of the collective body; it becomes an organism. This is by no means to say that the new organism, society, is a body in the same way as an animal or a plant, but it is an organism of its own kind, which is far more widely distinguished from those two than the animal from the plant. Both are made up from cells without power of self motion and without consciousness of their own; society on the other hand from individuals with their own power of movement and consciousness. If, however, the animal organism has, as a whole, a power of self motion and consciousness, they are lacking nevertheless to society as well as to the plant. But the individuals which form the society can entrust individuals among their members with functions through which the social forces are submitted to a uniform will, and uniform movements in the society are produced.

On the other hand the individual and society are much looser connected than the cell and the whole organism, in both plant and animal. The individuals can separate itself from one society and join another as emigration proves. That is impossible for a cell; for it the separation from the whole is death, if we leave certain cells of a particular kind out of account, such as the sperma and eggs in the procreative processes. Again society can forthwith impose on new individuals any change of form, without any change of substance, which is impossible for an animal body. Finally the
individuals who form society can, under circumstances, change the organs and organization of society, while anything of that kind is quite impossible in an animal or vegetable organism.

If, therefore, society is an organism, it is no animal organism, and to attempt to explain any phenomena peculiar to society from the laws of the animal organism is not less absurd than when the attempt is made to deduce peculiarities of the animal organism, such as self movement and consciousness, from the laws of vegetable being. Naturally this does not say there is not also something common to the various kinds of organisms.

Just as the animal, so will also the social organism survive so much the better in the struggle for existence the more unitary its movements, the stronger the binding forces, the greater the harmony of the parts. But society has no fixed skeleton, which supports the weaker parts, no skin which covers the whole, no circulation of the blood which nourishes all the parts, no heart which regulates it, no brain which makes a unity out of its knowing, its working and its movements. Its unity and harmony, as well as the coherence can only arise from the actions and will of its members. This unitary will will, however, be so much the more assured the more it springs from a strong impulse.

Among species of animals, in whom the social bond becomes a weapon in the struggle for life, this encourages consequently social impulses which in many species and many individuals grow to an extraordinary strength, so that they can overcome the impulse of self preservation and reproduction when they come in conflict with the same.

The commencement of the social impulse we can well look for in the interest which the simple fact of living together in society produces in the individuals for his fellows, to whose society he is accustomed from youth on. On the other hand reproduction and care for the progeny already render longer or shorter relations of a more intimate kind necessary between different individuals of the same species. And just as these relations have formed the starting point for the formation of societies, so could the corresponding impulses easily give the point of departure for the development of the social impulses.

These impulses themselves can vary according to the varying conditions of the various species, but a row of impulses forms the requisite conditions for the growth of any kind of society. In the first place naturally comes altruism, self sacrifice for the whole. Then bravery in the defence of the common interests; fidelity to the community; submission to the will of society; then obedience and discipline; truthfulness to society whose security is endangered or whose energies are wasted when they are misled in any way by false signals. Finally ambition, the sensibility to the praise and blame of society. These all are social impulses which we find expressed already among animal societies, many of them in a high degree.

These social impulses are nevertheless nothing but the highest virtues, they sum up the entire moral code. At the most they lack the love for justice, that is the impulse for equality. For its development there certainly is no place in the animal societies, because they only know natural and individual inequality, and not those called forth by social relations, the social inequalities. The lofty moral law, that the comrade ought never to be merely a means to an end, which the Kantians look on as the most wonderful achievement of Kant’s genius, and as the moral programme of the modern era, and for the entire future history of the world, that is in the animal world a commonplace. The development of human society first created a state of affairs in which the companion became a simple tool of others.

What appeared to a Kant as the creation of a higher world of spirits, is a product of the animal world. How narrowly the social impulses have grown up with the fight for existence, and to what an extent they originally were useful in the preservation of species, can be seen from the fact that their effect often limits itself to individuals whose maintenance is advantageous to the species. Quite a number of animals, which risk their lives to save younger or weaker comrades, kill without a scruple sick or aged comrades who are superfluous for the preservation of the race, and are become a burden to society. The “moral sense,” “sympathy,” does not extend to these elements. Even many
savages behave like that.

An animal impulse and nothing else is the moral law. Thence comes its mysterious nature, this 
voice in us which has no connection with any external impulse, or any apparent interest, this demon 
or god, which since Socrates and Plato, those moralists found in themselves who refused to deduce 
morality from self love or pleasure. Certainly a mysterious impulse, but not more mysterious than 
sexual love, the maternal love, the instinct of self preservation, the being of the organism itself and 
so many other things, which only belong to the world of phenomena and which no one looks on as 
products of a supersensuous world.

Because the moral law is the universal instinct, of equal force to the instinct of self preservation and 
reproduction, thence its force, thence its power which we obey without thought, thence our rapid 
decisions, in particular cases, whether an action is: good or bad, virtuous or vicious; thence the 
energy and decision of our moral judgment, and thence the difficulty to prove it when reason begins 
to analyze its grounds. Then one finally finds that to comprehend all means to pardon all, that 
everything is necessary, that nothing is good and bad.

Not from our organs of knowing, but from our impulses comes the moral law and the moral 
judgment as well as the feeling of duty and the conscience.

In many kinds of animals the social impulses attain such a strength, that they become stronger than 
all the rest. Do the former come in conflict with the latter, they then confront the latter with 
overpowering strength as commands of duty. Nevertheless that does not hinder in such a case a 
special impulse, say of self preservation or of reproduction being temporarily stronger than the 
social impulse and overcoming it. But is the danger past, then the strength of the self preserving 
impulse or the reproductive instinct shrivels up, just as that of reproduction after the completion of 
the act. The social instinct remains however, existing in the old force, regains the dominion over the 
individual and works now in him as the voice of conscience and of repentance. Nothing is more 
mistaken than to see in conscience the voice of fright of his fellows, their opinion or even their 
power of physical compulsion. It has effect even in respect of acts, which no one has heard of, even 
acts which appear to the neighbors very praiseworthy, it can even work as repugnance of acts which 
have been undertaken from fear of his fellows and their public opinion.

Public opinion, praise and blame are certainly very influential factors. But their effect assumes in 
advance a certain social impulse, namely, ambition, they cannot produce the social impulses.

We have no reason to assume that conscience is confined to man. We would find it difficult to find 
even in men, if everyone did not feel its effect on himself. Conscience is certainly a force, which 
does not obviously and openly show itself, but works only in the innermost being.

But nevertheless many investigators have gone so far as to posit even in animals a kind of 
conscience. Thus says Darwin in his book The Descent of Man:

“Besides Love and Sympathy the animals show other qualities connected with the social instincts, 
which we should call moral in men; and I agree with Agassiz that dogs have something very like a 
conscience. Dogs certainly have a certain power of self control, and this does not appear to be 
altogether a consequence of fear. As Braubach remarks, a dog will restrain itself from stealing food 
in the absence of its master.” If conscience and feeling of duty are a consequence of the lasting 
predominance of the social impulses in many species of animals, if these impulses are those through 
which the individuals of such species are the most constantly and most enduringly determined, 
while the force of the other impulses is subject to great oscillations, yet the force of the social 
impulse is not free from all oscillations. One of the most peculiar phenomena is that social animals, 
when united in greater numbers, also feel stronger social impulses. It is for example a well known 
fact that an entirely different spirit reigns in a well filled meeting then in a weak, that the bigger 
crowd alone has an inspiring effect on the speaker. In a crowd the individuals are not only more 
brave, that could be explained through the greater support which each believes he will get from his 
fellows; they are also more unselfish, more self sacrificing, more enthusiastic. Certainly then only
too often so much the more calculating, cowardly and selfish when they find themselves alone. And that applies not only in men but also in the social animals. Thus Espinas, in his book, Animal Societies, quotes an observation of Forel. The latter found:

“The courage of every ant, by the same form, increases in exact proportion to the number of its companions or friends, and decreases in exact proportion the more isolated it is from its companions. Every inhabitant of a very populous ant heap, is much more courageous than a similar one from a small population. The same female worker, which will allow herself to be killed ten times in the midst of her companions, will show itself extraordinarily timid, avoid the least danger, fly before even a much weaker ant so soon as she finds herself twenty steps from her own home.”

With the stronger social feeling there need not necessarily be bound up a higher faculty of intelligence. In general every instinct probably has the effect to somewhat obscure the exact observation of the external world. What we wish, that we readily believe, but what we fear that we easily exaggerate. The instincts have the effect that very easily many things appear disproportionately big or near, while others are overlooked. How blind and deaf the instinct for reproduction can render many animals at times is well known. The social instincts which do not show themselves as a rule so acutely and intensively, generally obscure much less the intellectual faculties. They can, however, influence them very considerably on occasions. Think, for instance, on the influence of faithfulness, and discipline among sheep, who follow their leading sheep blindly, wherever it may go.

The moral law in us can lead our intellect astray just as any other impulse. In itself it is neither a product of wisdom nor does it produce wisdom. What is apparently the most elevated and divine in us, is essentially the same as that which we look on as the commonest and most devilish. The moral law is of the same nature as the instinct for reproduction. Nothing is more ridiculous, than when the former is put on a pedestal and the latter is turned away with loathing and contempt. But no less false is it to infer that man can and ought to follow all his instincts without check. That is only so far true as it is impossible to condemn any one of these as such. But that by no means implies that they cannot come to cross purposes. It is simply impossible that any one should follow all his instincts without restraint, because they restrain one another. Which, however, at a given moment wins, and what consequences this victory brings for the individual and his society with it, there neither the Ethic of pleasure nor that of a moral law standing outside of space and time affords us any help.

If, however, the moral law is recognized as a social impulse, which like all the impulses is brought out in us by the struggle for life, the supersensuous world has lost a strong support in human thinking. The simple gods of Polytheism were already dethroned by natural Philosophy. If nevertheless a new Philosophy could arise which not only reawakened the belief in God and a supersensuous world but put it more firmly on a higher form, as was done in ancient times by Plato, and on the eve of the French Revolution by Kant, so did the cause lie in the unsolved problem of the moral law, to whose explanation neither its deduction from pleasure nor from the moral sense sufficed – and yet these offered the only “natural” causal explanation which seemed possible. Darwinism was the first to make an end to the division of man, which this rendered necessary, into a natural and animal on the one hand and a supernatural heavenly, on the other.

But with that was the entire ethical problem not yet solved. Were moral impulse, duty and conscience as well as the ground type of the virtues to be explained from the social impulse, yet this breaks down when it is a question of explaining the moral idea. Of that there is not the least sign in the animal world. Only man can set himself ideals and follow them. Whence come these? Are they prescribed to the human race from the beginning of all time as an irrevocable demand of nature or an eternal season, as commands which man does not produce but which confront man as a ruling force and show him the aims toward which he has ever more and more to strive? That was in the main the view of all thinkers of the 18th century, atheists as well as theists, materialists and idealists. This view took even in the mouth of the boldest materialism the tendency to assume a supernatural Providence, which indeed had nothing more to do in nature but still hovers over human
society. The evolution idea which recognized the descent of man from the animal world made this kind of idealism absurd in a materialistic mouth.

All the same before Darwin founded his epoch-making work that theory had arisen which revealed the secret of the moral ideal. It was the theory of Marx and Engels.

Anton Pannekoek 1912

Marxism And Darwinism

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I.

Darwinism

Two scientists can hardly be named who have, in the second half of the 19th century, dominated the human mind to a greater degree than Darwin and Marx. Their teachings revolutionized the conception that the great masses had about the world. For decades their names have been on the tongues of everybody, and their teachings have become the central point of the mental struggles which accompany the social struggles of today. The cause of this lies primarily in the highly scientific contents of their teachings.

The scientific importance of Marxism as well as of Darwinism consists in their following out the theory of evolution, the one upon the domain of the organic world, of things animate; the other, upon the domain of society. This theory of evolution, however, was in no way new, it had its advocates before Darwin and Marx; the philosopher, Hegel, even made it the central point of his philosophy. It is, therefore, necessary to observe closely what were the achievements of Darwin and Marx in this domain.

The theory that plants and animals have developed one from another is met with first in the nineteenth century. Formerly the question, “Whence come all these thousands and hundreds of thousands of different kinds of plants and animals that we know?”, was answered: “At the time of creation God created them all, each after its kind.” This primitive theory was in conformity with experience had and with the best information about the past that was available. According to available information, all known plants and animals have always been the same. Scientifically, this experience was thus expressed, “All kinds are invariable because the parents transmit their characteristics to their children.”

There were, however, some peculiarities among plants and animals which gradually forced a different conception to be entertained. They so nicely let themselves be arranged into a system which was first set up by the Swedish scientist Linnaeus. According to this system, the animals are divided into phyla, which are divided into classes, classes into orders, orders into families, families into genera, each of which contain a few species. The more resemblance there is in their characteristics, the nearer they stand towards each other in this system, and the smaller is the group to which they belong. All the animals classed as mammalian show the same general characteristics in their bodily frame. The herbivorous animals, and carnivorous animals, and monkeys, each of which belongs to a different order, are again differentiated. Bears, dogs, and cats, all of which are carnivorous animals, have much more in common in bodily form than they have with horses or monkeys. This conformity is still more obvious when we examine varieties of the same species; the cat, tiger and lion resemble each other in many respects where they differ from dogs and bears. If we turn from the class of mammals to other classes, such as birds or fishes, we find greater differences between classes than we find within a class. There still persists, however, a semblance in the formation of the body, the skeleton and the nervous system. These features first disappear when we turn from this main division, which embraces all the vertebrates, and go to the molluscs (soft
bodied animals) or to the polyps.

The entire animal world may thus be arranged into divisions and subdivisions. Had every different kind of animal been created entirely independent of all the others, there would be no reason why such orders should exist. There would be no reason why there should not be mammals having six paws. We would have to assume, then, that at the time of creation, God had taken Linnaeus’ system as a plan and created everything according to this plan. Happily we have another way of accounting for it. The likeness in the construction of the body may be due to a real family relationship. According to this conception, the conformity of peculiarities show how near or remote the relationship is, just as the resemblance between brothers and sisters is greater than between remote relatives. The animal classes were, therefore, not created individually, but descended one from another. They form one trunk that started with simple foundations and which has continually developed; the last and thin twigs are our present existing kinds. All species of cats descend from a primitive cat, which together with the primitive dog and the primitive bear, is the descendant of some primitive type of carnivorous animal. The primitive carnivorous animal, the primitive hoofed animal and the primitive monkey have descended from some primitive mammal, etc.

This theory of descent was advocated by Lamarck and by Geoffrey St. Hilaire. It did not, however, meet with general approval. These naturalists could not prove the correctness of this theory and, therefore, it remained only a hypothesis, a mere assumption. When Darwin came, however, with his main book, The Origin of Species struck like a thunderbolt; his theory of evolution was immediately accepted as a strongly proved truth. Since then the theory of evolution has become inseparable from Darwin’s name. Why so?

This was partly due to the fact that through experience ever more material was accumulated which went to support this theory. Animals were found which could not very well be placed into the classification such as oviparous mammals (that is, animals which lay eggs and nourish their offspring from their breast. - Translator) fishes having lungs, and invertebrate animals. The theory of descent claimed that these are simply the remnants of the transition between the main groups. Excavations have revealed fossil remains which looked different from animals living now. These remains have partly proved to be the primitive forms of our animals, and that the primitive animals have gradually developed to existing ones. Then the theory of cells was formed; every plant, every animal, consists of millions of cells and has been developed by incessant division and differentiation of single cells. Having gone so far, the thought that the highest organisms have descended from primitive beings having but a single cell, could not appear as strange.

All these new experiences could not, however, raise the theory to a strongly proved truth. The best proof for the correctness of this theory would have been to have an actual transformation from one animal kind to another take place before our eyes, so that we could observe it. But this is impossible. How then is it at all possible to prove that animal forms are really changing into new forms? This can be done by showing the cause, the propelling force of such development. This Darwin did. Darwin discovered the mechanism of animal development, and in doing so he showed that under certain conditions some animal kinds will necessarily develop into other animal-kinds. We will now make clear this mechanism.

Its main foundation is the nature of transmission, the fact that parents transmit their peculiarities to children, but that at the same time the children diverge from their parents in some respects and also differ from each other. It is for this reason that animals of the same kind are not all alike, but differ in all directions from the average type. Without this so-called variation it would be wholly impossible for one animal species to develop into another. All that is necessary for the formation of a new species is that the divergence from the central type become greater and that it goes on in the same direction until this divergence has become so great that the new animal no longer resembles the one from which it descended. But where is that force that could call forth the ever growing variation in the same direction?

Lamarck declared that this was owing to the usage and much exercise of certain organs; that, owing
to the continuous exercise of certain organs, these become ever more perfected. Just as the muscles of men’s legs get strong from running much, in the same way the lion acquired its powerful paws and the hare its speedy legs. In the same way the giraffes got their long necks because in order to reach the tree leaves, which they ate, their necks were stretched so that a short-necked animal developed to the long-necked giraffe. To many this explanation was incredible and it could not account for the fact that the frog should have such a green color which served him as a good protecting color.

To solve the same question, Darwin turned to another line of experience. The animal breeder and the gardener are able to raise artificially new races and varieties. When a gardener wants to raise from a certain plant a variety having large blossoms, all he has to do is to kill before maturity all those plants having small blossoms and preserve those having large ones. If he repeats this for a few years in succession, the blossoms will be ever larger, because each new generation resembles its predecessor, and our gardener, having always picked out the largest of the large for the purpose of propagation, succeeds in raising a plant with very large blossoms. Through such action, done sometimes deliberately and sometimes accidentally, people have raised a great number of races of our domesticated animals which differ from their original form much more than the wild kinds differ from each other.

If we should ask an animal-breeder to raise a long-necked animal from a short-necked one, it would not appear to him an impossibility. All he would have to do would be to choose those having partly longer necks, have them inter-bred, kill the young ones having narrow necks and again have the long-necked inter-breed. If he repeated this at every new generation the result would be that the neck would ever become longer and he would get an animal resembling the giraffe.

This result is achieved because there is a definite will with a definite object, which, to raise a certain variety, chooses certain animals. In nature there is no such will, and all the deviations must again be straightened out by interbreeding, so that it is impossible for an animal to keep on departing from the original stock and keep going in the same direction until it becomes an entirely different species. Where then, is that power in nature that chooses the animals just as the breeder does?

Darwin pondered this problem long before he found its solution in the “struggle for existence.” In this theory we have a reflex of the productive system of the time in which Darwin lived, because it was the capitalist competitive struggle which served him as a picture for the struggle for existence prevailing in nature. It was not through his own observation that this solution presented itself to him. It came to him by his reading the works of the economist Malthus. Malthus tried to explain that in our bourgeois world there is so much misery and starvation and privation because population increases much more rapidly than the existing means of subsistence. There is not enough food for all; people must therefore struggle with each other for their existence, and many must go down in this struggle. By this theory capitalist competition as well as the misery existing were declared as an unavoidable natural law. In his autobiography Darwin declares that it was Malthus’ book which made him think about the struggle for existence.

“In October, 1838, that is, fifteen months after I had begun my systematic inquiry, I happened to read for amusement Malthus on population, and being well prepared to appreciate the struggle for existence which everywhere goes on from long continuous observation of the habits of animals and plants, it at once struck me that under these circumstances favorable variations would tend to be preserved and unfavorable ones to be destroyed. The result of this would be the formation of new species. Here, then, I had at last got a theory by which to work.”

It is a fact that the increase in the birth of animals is greater than the existing food permits of sustaining. There is no exception to the rule that all organic beings tend to increase so rapidly that our earth would be overrun very soon by the offspring of a single pair, were these not destroyed. It is for this reason that a struggle for existence must arise. Every animal tries to live, does its best to eat, and seeks to avoid being eaten by others. With its particular peculiarities and weapons it struggles against the entire antagonistic world, against animals, cold, heat, dryness, inundations, and
other natural occurrences that may threaten to destroy it. Above all, it struggles with the animals of its own kind, who live in the same way, have the same peculiarities, use the same weapons and live by the same nourishment. This struggle is not a direct one; the hare does not struggle directly with the hare, nor the lion with the lion - unless it is a struggle for the female - but it is a struggle for existence, a race, a competitive struggle. All of them can not reach a grown-up age; most of them are destroyed, and only those who win the race remain. But which are the ones to win in the race? Those which, through their peculiarities, through their bodily structures are best able to find food or to escape an enemy; in other words, those which are best adapted to existing conditions will survive. “Because there are ever more individuals born than can remain alive, the struggle as to which shall remain alive must start again and that creature that has some advantage over the others will survive, but as these diverging peculiarities are transmitted to the new generations, nature itself does the choosing, and a new generation will arise having changed peculiarities.”

Here we have another application for the origin of the giraffe. When grass does not grow in some places, the animals must nourish themselves on tree leaves, and all those whose necks are too short to reach these leaves must perish. In nature itself there is selection, and nature selects only those having long necks. In conformity with the selection done by the animal breeder, Darwin called this process “natural selection.”

This process must necessarily produce new species. Because too many are born of a certain species, more than the existing food supply can sustain, they are forever trying to spread over a larger area. In order to procure their food, those living in the woods go to the plain, those living on the soil go into the water, and those living on the ground climb on trees. Under these new conditions divergence is necessary. These divergencies are increased, and from the old species a new one develops. This continuous movement of existing species branching out into new relations results in these thousands of different animals changing still more.

While the Darwinian theory explains thus the general descent of the animals, their transmutation and formation out of primitive beings, it explains, at the same time, the wonderful conformity throughout nature. Formerly this wonderful conformity could only be explained through the wise superintending care of God. Now, however, this natural descent is clearly understood. For this conformity is nothing else than the adaptation to the means of life. Every animal and every plant is exactly adapted to existing circumstances, for all those whose build is less conformable are less adapted and are exterminated in the struggle for existence. The green-frog, having descended from the brown-frog, must preserve its protecting color, for all those that deviate from this color are sooner found by the enemies and destroyed or find greater difficulty in obtaining their food and must perish.

It was thus that Darwin showed us, for the first time, that new species continually formed out of old ones. The theory of descent, which until then was merely a presumptive inference of many phenomena that could not be explained well in any other way, gained the certainty of an absolute inference of definite forces that could be proved. In this lies the main reason that this theory had so quickly dominated the scientific discussions and public attention.

II. Marxism

If we turn to Marxism we immediately see a great conformity with Darwinism. As with Darwin, the scientific importance of Marx’s work consists in this, that he discovered the propelling force, the cause of social development. He did not have to prove that such a development was taking place; every one knew that from the most primitive times new social forms ever supplanted older, but the causes and aims of this development were unknown.

In his theory Marx started with the information at hand in his time. The great political revolution that gave Europe the aspect it had, the French Revolution, was known to everyone to have been a
struggle for supremacy, waged by the bourgeois against nobility and royalty. After this struggle new class struggles originated. The struggle carried on in England by the manufacturing capitalists against the landowners dominated politics; at the same time the working class revolted against the bourgeoisie. What were all these classes? Wherein did they differ from each other? Marx proved that these class distinctions were owing to the various functions each one played in the productive process. It is in the productive process that classes have their origin, and it is this process which determines to what class one belongs. Production is nothing else than the social labor process by which men obtain their means of subsistence from nature. It is the production of the material necessities of life that forms the main structure of society and that determines the political relations and social struggles.

The methods of production have continuously changed with the progress of time. Whence came these changes? The manner of labor and the productive relationship depend upon the tools with which people work, upon the development of technique and upon the means of production in general. Because in the Middle Ages people worked with crude tools, while now they work with gigantic machinery, we had at that time small trade and feudalism, while now we have capitalism; it is also for this reason that at that time the feudal nobility and the small bourgeoisie were the most important classes, while now it is the bourgeoisie and the proletarians which are the classes.

It is the development of tools, of these technical aids which men direct, which is the main cause, the propelling force of all social development. It is self-understood that the people are ever trying to improve these tools so that their labor be easier and more productive, and the practice they acquire in using these tools, leads their thoughts upon further improvements. Owing to this development, a slow or quick progress of technique takes place, which at the same time changes the social forms of labor. This leads to new class relations, new social institutions and new classes. At the same time social, i. e., political struggles arise. Those classes predominating under the old process of production try to preserve artificially their institutions, while the rising classes try to promote the new process of production; and by waging the class struggles against the ruling class and by conquering them they pave the way for the further unhindered development of technique.

Thus the Marxian theory disclosed the propelling force and the mechanism of social development. In doing this it has proved that history is not something irregular, and that the various social systems are not the result of chance or haphazard events, but that there is a regular development in a definite direction. In doing this it was also proved that social development does not cease with our system, because technique continually develops.

Thus, both teachings, the teachings of Darwin and of Marx, the one in the domain of the organic world and the other upon the field of human society, raised the theory of evolution to a positive science.

In doing this they made the theory of evolution acceptable to the masses as the basic conception of social and biological development.

III.

Marxism and the Class Struggle

While it is true that for a certain theory to have a lasting influence on the human mind it must have a highly scientific value, yet this in itself is not enough. It quite often happened that a scientific theory was of utmost importance to science, nevertheless, with the probable exception of a few learned men, it evoked no interest whatsoever. Such, for instance, was Newton’s theory of gravitation. This theory is the foundation of astronomy, and it is owing to this theory that we have our knowledge of heavenly bodies, and can foretell the arrival of certain planets and eclipses. Yet, when Newton’s theory of gravitation made its appearance, a few English scientists were its only adherents. The broad mass paid no attention to this theory. It first became known to the mass by a popular book of Voltaire’s written a half century afterwards.
There is nothing surprising about this. Science has become a specialty for a certain group of learned men, and its progress concerns these men only, just as smelting is the smith’s specialty, and an improvement in the smelting of iron concerns him only. Only that which all people can make use of and which is found by everyone to be a life necessity can gain adherents among the large mass. When, therefore, we see that a certain scientific theory stirs up zeal and passion in the large mass, this can be attributed to the fact that this theory serves them as a weapon in the class struggle. For it is the class struggle that engages almost all the people.

This can be seen most clearly in Marxism. Were the Marxian economic teachings of no importance in the modern class struggle, then none but a few professional economists would spend their time on them. It is, however, owing to the fact that Marxism serves the proletarians as a weapon in the struggle against capitalism that the scientific struggles are centered on this theory. It is owing to this service that Marx’s name is honored by millions who know even very little of his teaching, and is despised by thousands that understand nothing of his theory. It is owing to the great role the Marxian theory plays in the class struggle that his theory is diligently studied by the large mass and that it dominates the human mind.

The proletarian class struggle existed before Marx for it is the offspring of capitalist exploitation. It was nothing more than natural that the workers, being exploited, should think about and demand another system of society where exploitation would be abolished. But all they could do was to hope and dream about it. They were not sure of its coming to pass. Marx gave to the labor movement and Socialism a theoretical foundation. His social theory showed that social systems were in a continuous flow wherein capitalism was only a temporary form. His studies of capitalism showed that owing to the continuous development of perfection of technique, capitalism must necessarily develop to Socialism. This new system of production can only be established by the proletarians struggling against the capitalists, whose interest it is to maintain the old system of production. Socialism is therefore the fruit and aim of the proletarian class struggle.

Thanks to Marx, the proletarian class struggle took on an entirely different form. Marxism became a weapon in the proletarian hands; in place of vague hopes he gave a positive aim, and in teaching a clear recognition of the social development he gave strength to the proletarian and at the same time he created the foundation for the correct tactics to be pursued. It is from Marxism that the workingmen can prove the transitoriness of capitalism and the necessity and certainty of their victory. At the same time Marxism has done away with the old utopian views that Socialism would be brought about by the intelligence and good will of some judicious men; as if Socialism were a demand for justice and morality; as if the object were to establish an infallible and perfect society. Justice and morality change with the productive system, and every class has different conceptions of them. Socialism can only be gained by the class whose interest lies in Socialism, and it is not a question about a perfect social system, but a change in the methods of production leading to a higher step, i. e., to social production.

Because the Marxian theory of social development is indispensable to the proletarians in their struggle, they, the proletarians, try to make it a part of their inner self; it dominates their thoughts, their feelings, their entire conception of the world. Because Marxism is the theory of social development, in the midst of which we stand, therefore Marxism itself stands at the central point of the great mental struggles that accompany our economic revolution.

IV.

Darwinism and the Class Struggle

That Marxism owes its importance and position only to the role it takes in the proletarian class struggle, is known to all. With Darwinism, however, things seem different to the superficial observer, for Darwinism deals with a new scientific truth which has to contend with religious prejudices and ignorance. Yet it is not hard to see that in reality Darwinism had to undergo the same
experiences as Marxism. Darwinism is not a mere abstract theory which was adopted by the scientific world after discussing and testing it in a mere objective manner. No, immediately after Darwinism made its appearance, it had its enthusiastic advocates and passionate opponents; Darwin’s name, too, was either highly honored by people who understood something of his theory, or despised by people who knew nothing more of his theory than that “man descended from the monkey,” and who were surely unqualified to judge from a scientific standpoint the correctness or falsity of Darwin’s theory. Darwinism, too, played a role in the class-struggle, and it is owing to this role that it spread so rapidly and had enthusiastic advocates and venomous opponents.

Darwinism served as a tool to the bourgeoisie in their struggle against the feudal class, against the nobility, clergy-rights and feudal lords. This was an entirely different struggle from the struggle now waged by the proletarians. The bourgeoisie was not an exploited class striving to abolish exploitation. Oh no. What the bourgeoisie wanted was to get rid of the old ruling powers standing in their way. The bourgeoisie themselves wanted to rule, basing their demands upon the fact that they were the most important class, the leaders of industry. What argument could the old class, the class that became nothing but useless parasites, bring forth against them? They leaned on tradition, on their ancient divine rights. These were their pillars. With the aid of religion the priests held the great mass in subjection and ready to oppose the demands of the bourgeoisie.

It was therefore for their own interests that the bourgeoisie were in duty bound to undermine the “divinity” right of rulers. Natural science became a weapon in the opposition to belief and tradition; science and the newly discovered natural laws were put forward; it was with these weapons that the bourgeoisie fought. If the new discoveries could prove that what the priests were teaching was false, the “divine” authority of these priests would crumble and the “divine rights” enjoyed by the feudal class would be destroyed. Of course the feudal class was not conquered by this only, as material power can only be overthrown by material power, but mental weapons become material tools. It is for this reason that the bourgeoisie relied so much upon material science.

Darwinism came at the desired time; Darwin's theory that man is the descendant of a lower animal destroyed the entire foundation of Christian dogma. It is for this reason that as soon as Darwinism made its appearance, the bourgeoisie grasped it with great zeal.

This was not the case in England. Here we again see how important the class struggle was for the spreading of Darwin’s theory. In England the bourgeoisie had already ruled a few centuries, and as a mass they had no interest to attack or destroy religion. It is for this reason that although this theory was widely read in England, it did not stir anybody; it merely remained a scientific theory without great practical importance. Darwin himself considered it as such, and for fear that his theory might shock the religious prejudices prevailing, he purposely avoided applying it immediately to men. It was only after numerous postponements and after others had done it before him, that he decided to make this step. In a letter to Haeckel he deplored the fact that his theory must hit upon so many prejudices and so much indifference that he did not expect to live long enough to see it break through these obstacles.

But in Germany things were entirely different, and Haeckel correctly answered Darwin that in Germany the Darwinian theory met with an enthusiastic reception. It so happened that when Darwin’s theory made its appearance, the bourgeoisie was preparing to carry on a new attack on absolutism and junkerism. The liberal bourgeoisie was headed by the intellectuals. Ernst Haeckel, a great scientist, and of still greater daring, immediately drew in his book, “Natural Creation,” most daring conclusions against religion. So, while Darwinism met with the most enthusiastic reception by the progressive bourgeoisie, it was also bitterly opposed by the reactionists.

The same struggle also took place in other European countries. Everywhere the progressive liberal bourgeoisie had to struggle against reactionary powers. These reactionists possessed, or were trying to obtain through religious followers, the power coveted. Under these circumstances, even the scientific discussions were carried on with the zeal and passion of a class struggle. The writings that appeared pro and con on Darwin have therefore the character of social polemics, despite the fact
that they bear the names of scientific authors. Many of Haeckel’s popular writings, when looked at from a scientific standpoint, are very superficial, while the arguments and remonstrances of his opponents show unbelievable foolishness that can only be met which only find their equal in the arguments used against Marx.

The struggle carried on by the liberal bourgeoisie against feudalism was not fought to its finish. This was partly owing to the fact that everywhere Socialist proletarians made their appearance, threatening all ruling powers, including the bourgeoisie. The liberal bourgeoisie relented, while the reactionary tendencies gained an upper hand. The former zeal in combating religion disappeared entirely, and while it is true that the liberals and reactionists were still fighting among each other, in reality, however, they neared each other. The interest formerly manifested in science as a weapon in the class struggle, has entirely disappeared, while the reactionary tendency that the masses must be brought to religion, became ever more pronounced.

The estimation of science has also undergone a change. Formerly the educated bourgeoisie founded upon science a materialistic conception of the universe, wherein they saw the solution of the universal riddle. Now mysticism has gained the upper hand; all that was solved appeared as very trivial, while all things that remained unsolved, appeared as very great indeed, embracing the most important life question. A sceptical, critical and doubting frame of mind has taken the place of the former jubilant spirit in favor of science.

This could also be seen in the stand taken against Darwin. “What does his theory show? It leaves unsolved the universal riddle! Whence comes this wonderful nature of transmission, whence the ability of animate beings to change so fitly?” Here lies the mysterious life riddle that could not be overcome with mechanical principles. Then, what was left of Darwinism in the light of later criticism?

Of course, the advance of science began to make rapid progress. The solution of one problem always brings a few more problems to the surface to be solved, which were hidden underneath the theory of transmission. This theory, that Darwin had to accept as a basis of inquiry, was ever more investigated, and a hot discussion arose about the individual factors of development and the struggle for existence. While a few scientists directed their attention to variation, which they considered due to exercise and adaptation to life (following the principle laid down by Lamarck) this idea was expressly denied by scientists like Weissman and others. While Darwin only assumed gradual and slow changes, De Vries found sudden and leaping cases of variation resulting in the sudden appearance of new species. All this, while it went to strengthen and develop the theory of descent, in some cases made the impression that the new discoveries rent asunder the Darwinian theory, and therefore every new discovery that made it appear so was hailed by the reactionists as a bankruptcy of Darwinism. This social conception had its influence on science. Reactionary scientists claimed that a spiritual element is necessary. The supernatural and insolvable has taken the place of Darwinism and that class which in the beginning was the banner bearer of Darwinism became ever more reactionary.

V.

Darwinism versus Socialism

Darwinism has been of inestimable service to the bourgeoisie in its struggle against the old powers. It was therefore only natural that bourgeoisdom should apply it against its later enemy, the proletarians; not because the proletarians were antagonistically disposed to Darwinism, but just the reverse. As soon as Darwinism made its appearance, the proletarian vanguard, the Socialists, hailed the Darwinian theory, because in Darwinism they saw a corroboration and completion of their own theory; not as some superficial opponents believe, that they wanted to base Socialism upon Darwinism but in the sense that the Darwinian discovery, – that even in the apparently stagnant organic world there is a continuous development – is a glorious corroboration and completion of the
Marxian theory of social development.

Yet it was natural for the bourgeoisie to make use of Darwinism against the proletarians. The bourgeoisie had to contend with two armies, and the reactionary classes know this full well. When the bourgeoisie attacks their authority, they point at the proletarians and caution the bourgeoisie to beware lest all authority crumble. In doing this, the reactionists mean to frighten the bourgeoisie so that they may desist from any revolutionary activity. Of course, the bourgeois representatives answer that there is nothing to fear; that their science but refutes the groundless authority of the nobility and supports them in their struggle against enemies of order.

At a congress of naturalists, the reactionary politician and scientist Virchow assailed the Darwinian theory on the ground that it supported Socialism. “Be careful of this theory,” he said to the Darwinists, “for this theory is very nearly related to the theory that caused so much dread in our neighboring country.” This allusion to the Paris Commune, made in the year famous for the hunting of Socialists, must have had a great effect. What shall be said, however, about the science of a professor who attacks Darwinism with the argument that it is not correct because it is dangerous! This reproach, of being in league with the red revolutionists, caused a lot of annoyance to Haeckel, the defendant of this theory. He could not stand it. Immediately afterwards he tried to demonstrate that it is just the Darwinian theory that shows the untenableness of the Socialist demands, and that Darwinism and Socialism “endure each other as fire and water.”

Let us follow Haeckel’s contentions, whose main thoughts re-occur in most authors who base their arguments against Socialism on Darwinism.

Socialism is a theory which presupposes natural equality for people, and strives to bring about social equality; equal rights, equal duties, equal possessions and equal enjoyments. Darwinism, on the contrary, is the scientific proof of inequality. The theory of descent establishes the fact that animal development goes in the direction of ever greater differentiation or division of labor; the higher or more perfect the animal, the greater the inequality existing. The same holds also good in society. Here, too, we see the great division of labor between vocations, class, etc., and the more society has developed, the greater become the inequalities in strength, ability and faculty. The theory of descent is therefore to be recommended as “the best antidote to the Socialist demand of making all equal.”

The same holds good, but to a greater extent, of the Darwinian theory of survival. Socialism wants to abolish competition and the struggle for existence. But Darwinism teaches us that this struggle is unavoidable and is a natural law for the entire organic world. Not only is this struggle natural, but it is also useful and beneficial. This struggle brings an ever greater perfection, and this perfection consists in an ever greater extermination of the unfit. Only the chosen minority, those who are qualified to withstand competition, can survive; the great majority must perish. Many are called, but few are chosen. The struggle for existence results at the same time in a victory for the best, while the bad and unfit must perish. This may be lamentable, just as it is lamentable that all must die, but the fact can neither be denied nor changed.

We wish to remark here how a small change of almost similar words serves as a defence of capitalism. Darwin spoke about the survival of the fittest, of those that are best fitted to the conditions. Seeing that in this struggle those that are better organized conquer the others, the conquerors were called the vigilant, and later the “best.” This expression was coined by Herbert Spencer. In thus winning on their field, the conquerors in the social struggle, the large capitalists, were proclaimed the best people.

Haeckel retained and still upholds this conception. In 1892 he said,

“Darwinism, or the theory of selection, is thoroughly aristocratic; it is based upon the survival of the best. The division of labor brought about by development causes an ever greater variation in character, an ever greater inequality among the individuals, in their activity, education and condition. The higher the advance of human culture, the greater the difference and gulf between the
various classes existing. Communism and the demands put up by the Socialists in demanding an
equality of conditions and activity is synonymous with going back to the primitive stages of
barbarism.”

The English philosopher Herbert Spencer already had a theory on social growth before Darwin.
This was the bourgeois theory of individualism, based upon the struggle for existence. Later he
brought this theory into close relation with Darwinism. “In the animal world,” he said, “the old,
weak and sick are ever rooted out and only the strong and healthy survive. The struggle for
existence serves therefore as a purification of the race, protecting it from deterioration. This is the
happy effect of this struggle, for if this struggle should cease and each one were sure of procuring
its existence without any struggle whatsoever, the race would necessarily deteriorate. The support
given to the sick, weak and unfit causes a general race degeneration. If sympathy, finding its
expressions in charity, goes beyond its reasonable bounds, it misses its object; instead of
diminishing, it increases the suffering for the new generations. The good effect of the struggle for
existence can best be seen in wild animals. They are all strong and healthy because they had to
undergo thousands of dangers wherein all those that were not qualified had to perish. Among men
and domestic animals sickness and weakness are so general because the sick and weak are
preserved. Socialism, having as its aim to abolish the struggle for existence in the human world,
will necessarily bring about an ever growing mental and physical deterioration.”

These are the main contentions of those who use Darwinism as a defence of the bourgeois system.
Strong as these arguments might appear at first sights they were not hard for the Socialists to
overcome. To a large extent, they are the old arguments used against Socialism, but wearing the
new garb of Darwinistic terminology, and they show an utter ignorance of Socialism as well as of
capitalism.

Those who compare the social organism with the animal body leave unconsidered the fact that men
do not differ like various cells or organs. but only in degree of their capacity. In society the division
of labor cannot go so far that all capacities should perish at the expense of one. What is more,
everyone who understands something of Socialism knows that the efficient division of labor does
not cease with Socialism; that first under Socialism real divisions will be possible. The difference
between the workers, their ability, and employments will not cease; all that will cease is the
difference between workers and exploiters.

While it is positively true that in the struggle for existence those animals that are strong, healthy and
well survive; yet this does not happen under capitalist competition. Here victory does not depend
upon perfection of those engaged in the struggle, but in something that lies outside of their body.
While this struggle may hold good with the small bourgeois, where success depends upon personal
abilities and qualifications, yet with the further development of capital, success does not depend
upon personal abilities, but upon the possession of capital. The one who has a larger capital at
command as will soon conquer the one who has a smaller capital at his disposal, although the latter
may be more skillful. It is not the personal qualities, but the possession of money that decides who
the victor shall be in the struggle. When the small capitalists perish, they do not perish as men but
as capitalists; they are not weeded out from among the living, but from the bourgeoisie. They still
exist, but no longer as capitalists. The competition existing in the capitalist system is therefore
something different in requisites and results from the animal struggle for existence.

Those people that perish as people are members of an entirely different class, a class that does not
take part in the competitive struggle. The workers do not compete with the capitalists, they only sell
their labor power to them. Owing to their being propertyless, they have not even the opportunity to
measure their great qualities and enter a race with the capitalists. Their poverty and misery cannot
be attributed to the fact that they fell in the competitive struggle on account of weakness; but
because they were paid very little for their labor power, it is for this very reason that, although their
children are born strong and healthy, they perish in great mass, while the children born to rich
parents, although born sick, remain alive by means of the nourishment and great care that is
bestowed on them. These children of the poor do not die because they are sick or weak, but because of external causes. It is capitalism which creates all those unfavorable conditions by means of exploitation, reduction of wages, unemployment crises, bad dwellings, and long hours of employment. It is the capitalist system that causes so many strong and healthy ones to succumb.

Thus the Socialists prove that different from the animal world, the competitive struggle existing between men does not bring forth the best and most qualified, but destroys many strong and healthy ones because of their poverty, while those that are rich, even if weak and sick, survive. Socialists prove that personal strength is not the determining factor, but it is something outside of man; it is the possession of money that determines who shall survive and who shall perish.

VI. Natural Law and Social Theory

The false conclusions reached by Haeckel and Spencer on Socialism are no surprise. Darwinism and Marxism are two distinct theories, one of which applies to the animal world, while the other applies to society. They supplement each other in the sense that, according to the Darwinian theory of evolution, the animal world develops up to the stage of man, and from then on, that is, after the animal has risen to man, the Marxian theory of evolution applies. When however, one wishes to carry the theory of one domain into that of the other, where different laws are applicable he must draw wrong inferences.

Such is the case when we wish to ascertain from natural law what social form is natural and applicable and this is just what the bourgeois Darwinists did. They drew the inference that the laws which govern in the animal world, where the Darwinian theory applies, apply with equal force in the capitalist system, and that therefore capitalism is a natural order and must endure forever. On the other hand, there were some Socialists who desired to prove that, according to Darwin, the Socialist system is the natural one. Said these Socialists,

“Under capitalism men do not carry on the struggle for existence with like tools, but with unlike ones artificially made. The natural superiority of those that are healthier, stronger, more intelligent or morally better, is of no avail so long as birth, class, or the possession of money control this struggle. Socialism, in abolishing all these artificial dissimilarities, will make equal provisions for all, and then only will the struggle for existence prevail, wherein the real personal superiorities will be the deciding factors.”

These critical arguments, while they are not bad when used as refutations against bourgeois Darwinists, are still faulty. Both sets of arguments, those used by the bourgeois Darwinists in favor of capitalism, and those of the Socialists, who base their Socialism on Darwin, are falsely rooted. Both arguments, although reaching opposite conclusions, are equally false because they proceed from the wrong premises that there is a natural and a permanent system of society.

Marxism has taught us that there is no such thing as a natural and a permanent social system, and that there can be none, or, to put it another way, every social system is natural, for every social system is necessary and natural under given conditions. There is not a single definite social system that can be accepted as natural; the various social systems take the place of one another as a result of developments in the means of production. Each system is therefore the natural one for its particular time. Capitalism is not the only natural order, as the bourgeoisie believes, and no Socialist system is the only natural system, as some Socialists try to prove. Capitalism was natural under the conditions of the nineteenth century, just as feudalism was in the Middle Ages, and as Socialism will be in the coming age. The attempt to put forward a certain system as the only natural and permanent one is as futile as if we were to take an animal and say that this animal is the most perfect of all animals. Darwinism teaches us that every animal is equally adapted and equally perfect in form to suit its special environments, and Marxism teaches us that every social system is particularly adapted to its conditions, and that in this sense it may be called good and perfect.
Herein lies the main reason why the endeavor of the bourgeois Darwinists to defend the foundering capitalist system is bound to fail. Arguments based on natural science, when applied to social questions, must almost always lead to wrong conclusions. This happens because, while nature is very slow in its development and changes during human history are practically imperceptible, so that it may almost be regarded as stable, human society nevertheless undergoes quick and continuous changes. In order to understand the moving force and the cause of social development, we must study society as such. It is only here that we can find the reason of social development. Marxism and Darwinism should remain in their own domains; they are independent of each other and there is no direct connection between them.

Here arises a very important question. Can we stop at the conclusion that Marxism applies only to society and that Darwinism applies only to the organic world, and that neither of these theories is applicable in the other domain? In practice it is very convenient to have one principle for the human world and another one for the animal world. In having this, however, we forget that man is also an animal. Man has developed from an animal, and the laws that apply to the animal world cannot suddenly lose their applicability to man. It is true that man is a very peculiar animal, but if that is the case it is necessary to find from these very peculiarities why those principles applicable to all animals do not apply to men, and why they assume a different form.

Here we come to another grave problem. The bourgeois Darwinists do not encounter such a problem; they simply declare that man is an animal, and without further ado they set about to apply the Darwinian principles to men. We have seen to what erroneous conclusions they come. To us this question is not so simple; we must first be clear about the differences between men and animals, and then we can see why, in the human world, the Darwinian principles change into different ones, namely, into Marxism.

VII.

The Sociability of Man

The first peculiarity that we observe in man is that he is a social being. In this he does not differ from all animals, for even among the latter there are many species that live socially among themselves. But man differs from all those that we have observed until now in dealing with the Darwinian theory; he differs from those animals that do not live socially, but that struggle with each other for subsistence. It is not with the rapacious animals which live separately that man must be compared, but with those that live socially. The sociability of animals is a power that we have not yet spoken of; a power that calls forth new qualities among animals.

It is an error to regard the struggle for existence as the only power giving shape to the organic world. The struggle for existence is the main power that causes the origin of new species, but Darwin himself knew full well that other powers co-operate which give shape to the forms, habits, and peculiarities of animate things. In his “Descent of Man” Darwin elaborately treated sexual selection and showed that the competition of males for females gave rise to the gay colors of the birds and butterflies and also to the singing voices of birds. There he also devoted a chapter to social living. Many illustrations on this head are also to be found in Kropotkin’s book, “Mutual Aid as a Factor in Evolution.” The best representation of the effects of sociability are given in Kautsky’s “Ethics and the Materialistic Conception of History.”

When a number of animals live in a group, herd or flock, they carry on the struggle for existence in common against the outside world; within such a group the struggle for existence ceases. The animals which live socially no longer wage a struggle against each other, wherein the weak succumb; just the reverse, the weak enjoy the same advantages as the strong. When some animals have the advantage by means of greater strength, sharper smell, or experience in finding the best pasture or in warding off the enemy, this advantage does not accrue only to these better fitted, but also to the entire group. This combining of the animals’ separate powers into one unit gives to the
group a new and much stronger power than any one individual possessed, even the strongest. It is owing to this united strength that the defenseless plant-eaters can ward off rapacious animals. It is only by means of this unity that some animals are able to protect their young.

A second advantage of sociability arises from the fact that where animals live socially, there is a possibility of the division of labor. Such animals send out scouts or place sentinels whose object it is to look after the safety of all, while others spend their time either in eating or in plucking, relying upon their guards to warn them of danger.

Such an animal society becomes, in some respects a unit, a single organism. Naturally, the relation remains much looser than the cells of a single animal body; nevertheless, the group becomes a coherent body, and there must be some power that holds together the individual members.

This power is found in the social motives, the instinct that holds them together and causes the continuance of the group. Every animal must place the interest of the entire group above his own; it must always act instinctively for the advantage and maintenance of the group without consideration of itself. As long as the weak plant-eaters think of themselves only and run away when attacked by a rapacious animal, each one minding his life only, the entire herd disappears. Only when the strong motive of self-preservation is suppressed by a stronger motive of union, and each animal risks its life for the protection of all, only then does the herd remain and enjoy the advantages of sticking together. In such a case, self-sacrifice, bravery, devotion, discipline and consciousness must arise, for where these do not exist society dissolves; society can only exist where these exist.

These instincts, while they have their origin in habit and necessity, are strengthened by the struggle for existence. Every animal herd still stands in a competitive struggle against the same animals of a different herd; those that are best fitted to withstand the enemy will survive, while those that are poorer equipped will perish. That group in which the social instinct is better developed will be able to hold its ground, while the group in which social instinct is low will either fall an easy prey to its enemies or will not be in a position to find favorable feeding places. These social instincts become therefore the most important and decisive factors that determine who shall survive in the struggle for existence. It is owing to this that the social instincts have been elevated to the position of predominant factors.

These relations throw an entirely new light upon the views of the bourgeois Darwinists. Their claim is that the extermination of the weak is natural and that it is necessary in order to prevent the corrosion of the race, and that the protection given to the weak serves to deteriorate the race. But what do we see? In nature itself, in the animal world, we find that the weak are protected; that it is not by their own personal strength that they maintain themselves, and that they are not brushed aside on account of their personal weakness. This arrangement does not weaken the group, but gives to it new strength. The animal group in which mutual aid is best developed is best fit to maintain itself in the strife. That which, according to the narrow conception appeared as a cause of weakness, becomes just the reverse, a cause of strength.

The sociable animals are in a position to beat those that carry on the struggle individually. This so-called degenerating and deteriorating race carries off the victory and practically proves itself to be the most skilful and best.

Here we first see fully how near sighted, narrow and unscientific are the claims and arguments of the bourgeois Darwinists. Their natural laws and their conceptions of what is natural are derived from a part of the animal world, from those which man resembles least, while those animals that practically live under the same circumstances as man are left unobserved. The reason for this can be found in the bourgeoisie’s own circumstances; they themselves belong to a class where each competes individually against the other. Therefore, they see among animals only that form of the struggle for existence. It is for this reason that they overlook those forms of the struggle that are of greatest importance to men.

It is true that these bourgeois Darwinists are aware of the fact that man is not ruled by mere egoism
without regard for his neighbors. The bourgeois scientists say very often that every man is
possessed of two feelings, the egotistical, or self-love, and the altruistic, the love of others. But as
they do not know the social origin of this altruism, they cannot understand its limitations and
conditions. Altruism in their mouths becomes a very indistinct idea which they don’t know how to
handle.

Everything that applies to the social animals applies also to man. Our ape-like ancestors and the
primitive men developing from them were all defenseless, weak animals who, as almost all apes do,
lived in tribes. Here the same social motives and instincts had to arise which later developed to
moral feelings. That our customs and morals are nothing other than social feelings, feelings that we
find among animals, is known to all; even Darwin spoke about “the habits of animals which would
be called moral among men.” The difference is only in the measure of consciousness; as soon as
these social feelings become clear to men, they assume the character of moral feelings. Here we see
that the moral conception – which bourgeois authors considered as the main distinction between
men and animals – is not common to men, but is a direct product of conditions existing in the
animal world.

It is in the nature of the origin of these moral feelings that they do not spread further than the social
group to which the animal or the man belongs. These feelings serve the practical object of keeping
the group together; beyond this they are useless. In the animal world, the range and nature of the
social group is determined by the circumstances of life, and therefore the group almost always
remains the same. Among men, however, the groups, these social units, are ever changing in
accordance with economic development, and this also changes the social instincts.

The original groups, the stems of the wild and barbarian people, were more strongly united than the
animal groups. Family relationship and a common language strengthened this union further. Every
individual had the support of the entire tribe. Under such conditions, the social motives, the moral
feelings, the subordination of the individual to the whole, must have developed to the utmost. With
the further development of society, the tribes are dissolved and their places are taken by new unions,
by towns and peoples.

New formations step into the place of the old ones, and the members of these groups carry on the
struggle for existence in common against other peoples. In equal ratio with economic development,
the size of these unions increases, the struggle of each against the other decreases, and social
feelings spread. At the end of ancient times we find that all the people known then formed a unit,
the Roman Empire, and at that time arose the theory – the moral feelings having their influence on
almost all the people – which led to the maxim that all men are brothers.

When we regard our own times, we see that economically all the people form one unit, although a
very weak one; nevertheless the abstract feeling of brotherhood becomes ever more popular. The
social feelings are strongest among members of the same class, for classes are the essential units
embodying particular interests and including certain members. Thus we see that the social units and
social feelings change in human society. These changes are brought about by economic changes,
and the higher the stage of economic development, the higher and nobler the social feelings.

VIII.

Tools, Thought and Language

Sociability, with its consequences, the moral feelings, is a peculiarity which distinguishes man from
some, but not from all, animals. There are, however, some peculiarities which belong to man only,
and which separate him from the entire animal world. These, in the first instance, are language, then
reason. Man is also the only animal that makes use of self-made tools.

For all these things, animals have but the slightest propensity, but among men, these have developed
essentially new characteristics. Many animals have some kind of voice, and by means of sounds
they can come to some understanding, but only man has such sounds as serve as a medium for
naming things and actions. Animals also have brains with which they think, but the human mind shows, as we shall see later, an entirely new departure, which we designate as reasonable or abstract thinking. Animals, too, make use of inanimate things which they use for certain purposes; for instance, the building of nests. Monkeys sometimes use sticks or stones, but only man uses tools which he himself deliberately makes for particular purposes. These primitive tendencies among animals show us that the peculiarities possessed by man came to him, not by means of some wonderful creation, but by continuous development.

Animals living isolated can not arrive at such a stage of development. It is only as a social being that man can reach this stage. Outside the pale of society, language is just as useless as an eye in darkness, and is bound to die. Language is possible only in society, and only there is it needed as a means by which members may understand one another. All social animals possess some means of understanding each other, otherwise they would not be able to execute certain plans conjointly. The sounds that were necessary as a means of communication for the primitive man while at his tasks must have developed into names of activities, and later into names of things.

The use of tools also presupposes a society, for it is only through society that attainments can be preserved. In a state of isolated life every one has to make discoveries for himself and with the death of the discoverer the discovery also becomes extinct, and each has to start anew from the very beginning. It is only through society that the experience and knowledge of former generations can be preserved, perpetuated, and developed. In a group or body a few may die, but the group, as such, does not. It remains. Knowledge in the use of tools is not born with man, but is acquired later. Mental tradition, such as is possible only in society, is therefore necessary.

While these special characteristics of man are inseparable from his social life, they also stand in strong relation to each other. These characteristics have not been developed singly, but all have progressed in common. That thought and language can exist and develop only in common is known to everyone who has but tried to think of the nature of his own thoughts. When we think or consider, we, in fact, talk to ourselves; we observe then that it is impossible for us to think clearly without using words. Where we do not think with words our thoughts remain indistinct and we can not combine the various thoughts. Everyone can realize this from his own experience. This is because so-called abstract reason is perceptive thought and can take place only by means of perceptions. Perceptions we can designate and hold only by means of names. Every attempt to broaden our minds, every attempt to advance our knowledge must begin by distinguishing and classifying by means of names or by giving to the old ones a more precise meaning. Language is the body of the mind, the material by which all human science can be built up.

The difference between the human mind and the animal mind was very aptly shown by Schopenhauer.

This citation is quoted by Kautsky in his “Ethics and the Materialist Conception of History” (pages 139-40, English Translation). The animal’s actions are dependent upon visual motives, it is only by these that it sees, hears or observes in any other way. We can always tell what induced the animal to do this or the other act, for we, too, can see it if we look. With man’s however, it is entirely different. We can not foretell what he will do, for we do not know the motives that induce him to act; they are thoughts in his head. Man considers, and in so doing, all his knowledge, the result of former experience, comes into play, and it is then that he decides how to act. The acts of an animal depend upon immediate impression, while those of man depend upon abstract conceptions, upon his thinking and perceiving. Man is at the same time influenced by finer invisible motives. Thus all his movements bear the impress of being guided by principles and intentions which give them the appearance of independence and obviously distinguishes them from those of animals.

Owing to their having bodily wants, men and animals are forced to seek to satisfy them in the natural objects surrounding them. The impression on the mind is the immediate impulse and beginning; the satisfaction of the wants is the aim and end of the act. With the animal, action follows immediately after impression. It sees its prey or food and immediately it jumps, grasps,
eats, or does that which is necessary for grasping, and this is inherited as an instinct. The animal hears some hostile sound, and immediately it runs away if its legs are so developed to run quickly, or lies down like dead so as not to be seen if its color serves as a protector. Between man’s impressions and acts, however, there comes into his head a long chain of thoughts and considerations. His actions will depend upon the result of these considerations.

Whence comes this difference? It is not hard to see that it is closely associated with the use of tools. In the same manner that thought arises between man’s impressions and acts, the tool comes in between man and that which he seeks to attain. Furthermore, since the tool stands between man and outside objects, thought must arise between the impression and the performance. Man does not start empty-handed against his enemy or tear down fruit, but he goes about it in a roundabout manner, he takes a tool, a weapon (weapons are also tools) which he uses against the hostile animal; therefore his mind must also make the same circuit, not follow the first impressions, but it must think of the tools and then follow through to the object. This material circuit causes the mental circuit; the thoughts leading to a certain act are the result of the tools necessary for the performance of the act.

Here we took a very simple case of primitive tools and the first stages of mental development. The more complicated technique becomes, the greater is the material circuit, and as a result the mind has to make greater circuits. When each made his own tools, the thought of hunger and struggle must have directed the human mind to the making of tools. Here we have a longer chain of thoughts between the impressions and the ultimate satisfaction of men’s needs. When we come down to our own times, we find that this chain is very long and complicated. The worker who is discharged foresees the hunger that is bound to come; he buys a newspaper in order to see whether there is any demand for laborers; he goes to the railroad, offers himself for a wage which he will get only long afterwards, so that he may be in a position to buy food and thus protect himself from starvation. What a long circuitous chain the mind must make before it reaches its destiny. But it agrees with our highly developed technique, by means of which man can satisfy his wants.

Man, however, does not rule over one tool only, but over many, which he applies for different purposes, and from which he can choose. Man, because of these tools, is not like the animal. The animal never advances beyond the tools and weapons with which it was born, while man makes his tools and changes them at will. Man, being an animal using different tools, must possess the mental ability to choose them. In his head various thoughts come and go, his mind considers all the tools and the consequences of their application, and his actions depend upon these considerations. He also combines one thought with another, and holds fast to the idea that fits in with his purpose.

Animals have not this capacity; it would be useless for them for they would not know what to do with it. On account of their bodily form, their actions are circumscribed within narrow bounds. The lion can only jump upon his prey, but can not think of catching it by running after it. The hare is so formed that it can run; it has no other means of defense although it may like to have. These animals have nothing to consider except the moment of jumping or running. Every animal is so formed as to fit into some definite place. Their actions must become strong habits. These habits are not unchangeable. Animals are not machines, when brought into different circumstances they may acquire different habits. It is not in the quality of their brains, but in the formation of their bodies that animal restrictions lie. The animal’s action is limited by its bodily form and surroundings, and consequently it has little need for reflection. To reason would therefore be useless for it and would only lead to harm rather than to good.

Man, on the other hand, must possess this ability because he exercises discretion in the use of tools and weapons, which he chooses according to particular requirements. If he wants to kill the fleet hare, he takes the bow and arrow; if he meets the bear, he uses the axe, and if he wants to break open a certain fruit he takes a hammer. When threatened by danger, man must consider whether he shall run away or defend himself by fighting with weapons. This ability to think and to consider is indispensable to man in his use of artificial tools.

This strong connection between thoughts, language, and tools, each of which is impossible without
the other, shows that they must have developed at the same time. How this development took place, we can only conjecture. Undoubtedly it was a change in the circumstances of life that changed men from our ape-like ancestors. Having migrated from the woods, the original habitat of apes, to the plain, man had to undergo an entire change of life. The difference between hands and feet must have developed then. Sociability and the ape-like hand, well adapted for grasping, had a due share in the new development. The first rough objects, such as stones or sticks, came to hand unsought, and were thrown away. This must have been repeated so often that it must have left an impression on the minds of those primitive men.

To the animal, surrounding nature is a single unit, of the details of which it is unconscious. It can not distinguish between various objects. Our primitive man, at his lowest stage, must have been at the same level of consciousness. From the great mass surrounding him, some objects (tools) come into his hands which he used in procuring his existence. These tools, being very important objects, soon were given some designation, were designated by a sound which at the same time named the particular activity. Owing to this sound, or designation, the tool and the particular kind of activity stands out from the rest of the surroundings. Man begins to analyze the world by concepts and names, self-consciousness makes its appearance, artificial objects are purposely sought and knowingly made use of while working.

This process – for it is a very slow process – marks the beginning of our becoming men. As soon as men deliberately seek and apply certain tools, we can say that these are being developed; from this stage to the manufacturing of tools, there is only one step. The first crude tools differ according to use; from the sharp stone we get the knife, the bolt, the drill, and the spear; from the stick we get the hatchet. With the further differentiation of tools, serving later for the division of labor, language and thought develop into richer and newer forms, while thought leads man to use the tools in a better way, to improve old and invent new ones.

So we see that one thing brings on the other. The practice of sociability and the application to labor are the springs in which technique, thought, tools and science have their origin and continually develop. By his labor, the primitive ape-like man has risen to real manhood. The use of tools marks the great departure that is ever more widening between men and animals.

IX. Animal Organs and Human Tools

In animal organs and human tools we have the main difference between men and animals. The animal obtains its food and subdues its enemies with its own bodily organs; man does the same thing with the aid of tools. Organ (organon) is a Greek word which also means tools. Organs are natural, adnated (grown-on) tools of the animal. Tools are the artificial organs of men. Better still, what the organ is to the animal, the hand and tool is to man. The hands and tools perform the functions that the animal must perform with its own organs. Owing to the construction of the hand to hold various tools, it becomes a general organ adapted to all kinds of work; it becomes therefore an organ that can perform a variety of functions.

With the division of these functions, a broad field of development is opened for men which animals do not know. Because the human hand can use various tools, it can combine the functions of all possible organs possessed by animals. Every animal is built and adapted to a certain definite surrounding. Man, with his tools, is adapted to all circumstances and equipped for all surroundings. The horse is built for the prairie, and the monkey is built for the forest. In the forest, the horse would be just as helpless as the monkey would be if brought to the prairie. Man, on the other hand, uses the axe in the forest, and the spade on the prairie. With his tools, man can force his way in all parts of the world and establish himself all over. While almost all animals can live in particular regions, such as supply their wants, and if taken to different regions cannot exist, man has conquered the whole world. Every animal has, as a zoologist expressed it once, its strength by
which means it maintains itself in the struggle for existence, and its weakness, owing to which it falls a prey to others and cannot multiply itself. In this sense, man has only strength and no weakness. Owing to his having tools, man is the equal of all animals. As these tools do not remain stationary, but continually improve, man grows above every animal. His tools make him master of all creation, the king of the earth.

In the animal world there is also a continuous development and perfection of organs. This development, however, is connected with the changes of the animal’s body, which makes the development of the organs infinitely slow, as dictated by biological laws. In the development of the organic world, thousands of years amount to nothing. Man, however, by transferring his organic development upon external objects has been able to free himself from the chain of biologic law. Tools can be transformed quickly, and technique makes such rapid strides that, in comparison with the development of animal organs, it must be called marvelous. Owing to this new road, man has been able, within the short period of a few thousand years, to rise above the highest animal. With the invention of these implements, man got to be a divine power, and he takes possession of the earth as his exclusive dominion. The peaceful and hitherto unhindered development of the organic world ceases to develop according to the Darwinian theory. It is man that acts as breeder, tamer, cultivator; and it is man that does the weeding. It is man that changes the entire environment, making the further forms of plants and animals suit his aim and will.

With the origin of tools, further changes in the human body cease. The human organs remain what they were, with the exception of the brain. The human brain had to develop together with tools; and, in fact, we see that the difference between the higher and lower races of mankind consists mainly in the contents of their brains. But even the development of this organ had to stop at a certain stage. Since the beginning of civilization, the functions of the brain are ever more taken away by some artificial means; science is treasured up in books. Our reasoning faculty of today is not much better than the one possessed by the Greeks, Romans or even the Teutons, but our knowledge has grown immensely, and this is greatly due to the fact that the mental organ was unburdened by its substitutes, the books.

Having learned the difference between men and animals, let us now again consider how they are affected by the struggle for existence. That this struggle is the cause of perfection and the weeding out of the imperfect, can not be denied. In this struggle the animals become ever more perfect. Here, however, it is necessary to be more precise in expression and in observation of what perfection consists. In being so, we can no longer say that animals as a whole struggle and become perfected. Animals struggle and compete by means of their particular organs. Lions do not carry on the struggle by means of their tails; hares do not rely on their eyes; nor do the falcons succeed by means of their beaks. Lions carry on the struggle by means of their saltatory (leaping) muscles and their teeth; hares rely upon their paws and ears, and falcons succeed on account of their eyes and wings. If now we ask what is it that struggles and what competes, the answer is, the organs struggle. The muscles and teeth of the lion, the paws and ears of the hare, and the eyes and wings of the falcon carry on the struggle. It is in this struggle that the organs become perfected. The animal as a whole depends upon these organs and shares their fate.

Let us now ask the same question about the human world. Men do not struggle by means of their natural organs, but by means of artificial organs, by means of tools (and weapons we must understand as tools). Here, too, the principle of perfection and the weeding out of the imperfect, through struggle, holds true. The tools struggle, and this leads to the ever greater perfection of tools. Those groups of tribes that use better tools and weapons can best secure their maintenance, and when it comes to a direct struggle with another race, the race that is better equipped with artificial tools will win. Those races whose technical aids are better developed, can drive out or subdue those whose artificial aids are not developed. The European race dominates because its external aids are better.

Here we see that the principle of the struggle for existence, formulated by Darwin and emphasized
by Spencer, has a different effect on men than on animals. The principle that struggle leads to the
perfection of the weapons used in the strife, leads to different results between men and animals. In
the animal, it leads to a continuous development of natural organs; that is the foundation of the
theory of descent, the essence of Darwinism. In men, it leads to a continuous development of tools,
of the means of production. This, however, is the foundation of Marxism. Here we see that Marxism
and Darwinism are not two independent theories, each of which applies to its special domain,
without having anything in common with the other. In reality, the same principle underlies both
theories. They form one unit. The new course taken by men, the substitution of tools for natural
organs, causes this fundamental principle to manifest itself differently in the two domains; that of
the animal world to develop according to Darwinians principle, while among mankind the Marxian
principle applies. When men freed themselves from the animal world, the development of tools and
productive methods, the division of labor and knowledge became the propelling force in social
development. It is these that brought about the various systems, such as primitive communism, the
peasant system, the beginnings of commodity production, feudalism, and now modern capitalism,
and which bring us ever nearer to Socialism.

X.
Capitalism and Socialism

The particular form that the Darwinian struggle for existence assumes in development is determined
by men’s sociability and their use of tools. The struggle for existence, while it is still carried on
among members of different groups, nevertheless ceases among members of the same group, and its
place is taken by mutual aid and social feeling. In the struggle between groups, technical equipment
decides who shall be the victor; this results in the progress of technique. These two circumstances
lead to different effects under different systems. Let us see in what manner they work out under
capitalism.

When the bourgeoisie gained political power and made the capitalist system the dominating one, it
began by breaking the feudal bonds and freeing the people from all feudal ties. It was essential for
capitalism that every one should be able to take part in the competitive struggle; that no one’s
movements be tied up or narrowed by corporate duties or hampered by legal statutes, for only thus
was it possible for production to develop its full capacity. The workers must have free command
over themselves and not be tied up by feudal or guild duties, for only as free workers can they sell
their labor-power to the capitalists as a whole commodity, and only as free laborers can the
capitalists use them. It is for this reason that the bourgeoisie has done away with all old ties and
duties. It made the people entirely free, but at the same time left them entirely isolated and
unprotected. Formerly the people were not isolated; they belonged to some corporation; they were
under the protection of some lord or commune, and in this they found strength. They were a part of
a social group to which they owed duties and from which they received protection. These duties the
bourgeoisie abolished; it destroyed the corporations and abolished the feudal relations. The freeing
of labor meant at the same time that all refuge was taken away from him and that he could no longer
rely upon others.

Every one had to rely upon himself. Alone, free from all ties and protection, he must struggle
against all.

It is for this reason that, under capitalism, the human world resembles mostly the world of rapacious
animals and it is for this very reason that the bourgeois Darwinists looked for men’s prototype
among animals living isolated. To this they were led by their own experience. Their mistake,
however, consisted in considering capitalist conditions as everlasting. The relation existing between
our capitalist competitive system and animals living isolated, was thus expressed by Engels in his
book, “Anti-Duehring” (page 239. This may also be found on page 59 of “Socialism, Utopian and
Scientific”) as follows:
“Finally, modern industry and the opening of the world market made the struggle universal and at the same time gave it unheard-of virulence. Advantages in natural or artificial conditions of production now decide the existence or non-existence of individual capitalists as well as of whole industries and countries. He that falls is remorselessly cast aside. It is the Darwinian struggle of the individual for existence transferred from Nature to society with intensified violence. The conditions of existence natural to the animal appear as the final term of human development.”

What is that which carries on the struggle in this capitalist competition, the perfectness of which decides the victory?

First come technical tools, machines. Here again applies the law that struggle leads to perfection. The machine that is more improved outstrips the less improved, the machines that cannot perform much, and the simple tools are exterminated and machine technique develops with gigantic strides to ever greater productivity. This is the real application of Darwinism to human society. The particular thing about it is that under capitalism there is private property, and behind every machine there is a man. Behind the gigantic machine there is a big capitalist and behind the small machine there is a small capitalist. With the defeat of the small machine, the small capitalist, as capitalist, perishes with all his hopes and happiness. At the same time the struggle is a race of capital. Large capital is better equipped; large capital is getting ever larger. This concentration of capital undermines capital itself, for it diminishes the bourgeoisie whose interest it is to maintain capitalism, and it increases that mass which seeks to abolish it. In this development, one of the characteristics of capitalism is gradually abolished. In the world where each struggles against all and all against each, a new association develops among the working class, the class organization. The working class organizations start with ending the competition existing between workers and combine their separate powers into one great power in their struggle with the outside world. Everything that applies to social groups also applies to this class organization, brought about by natural conditions. In the ranks of this class organization, social motives, moral feelings, self-sacrifice and devotion for the entire body develop in a most splendid way. This solid organization gives to the working class that great strength which it needs in order to conquer the capitalist class. The class struggle which is not a struggle with tools but for the possession of tools, a struggle for the right to direct industry, will be determined by the strength of the class organization.

Let us now look at the future system of production as carried on under Socialism. The struggle leading to the perfection of the tools does not cease. As before under capitalism, the inferior machine will be outdistanced and brushed aside by the one that is superior. As before, this process will lead to greater productivity of labor. But private property having been abolished, there will no longer be a man behind each machine calling it his own and sharing its fate. Machines will be common property, and the displacement of the less developed by the better developed machinery will be carried out upon careful consideration.

With the abolition of classes the entire civilized world will become one great productive community. Within this community mutual struggle among members will cease and will be carried on with the outside world. It will no longer be a struggle against our own kind, but a struggle for subsistence, a struggle against nature. But owing to development of technique and science, this can hardly be called a struggle. Nature is subject to man and with very little exertion from his side she supplies him with abundance. Here a new career opens for man: man’s rising from the animal world and carrying on his struggle for existence by the use of tools, ceases, and a new chapter of human history begins.

Anton Pannekoek
Sir Norman Lockyer, whose name is commemorated by this lecture, was fortunate in certain respects. His work on the chemistry and physics of the sun, revolutionary as it was from the point of view of pure science, did not bring him into conflict with established interests either in religion or politics. This was, in a way, accidental. The scriptures might well have contained misleading passages concerning the composition of the sun, as they do about its motion. And had the persons...
with a vested interest in nineteenth century methods of illumination been sufficiently farsighted, they would have realised that a study of line spectra was likely to render obsolete all lighting methods based on the emission of a continuous spectrum, and have done their best to discourage this study.

The student of human biology can hardly hope for such immunity from worldly contacts. He may discover facts which go far to disprove the theories by which current politics, economics, hygiene, religion, and morality are supported. And he will not even have the satisfaction of whole-heartedly taking sides in a controversy. At one moment he may find himself attacking a religious dogma, at the next supporting the Pope against people who regard themselves as progressive. If he defends the medical profession against some of its opponents, he will be bound to admit that the Pharmacopeia embodies many practices which have absolutely no scientific foundation. In most human controversies truth resembles the Mexican god Yaotl, familiar to readers of Cabell's "The Silver Stallion." It is the enemy on both sides.

I shall naturally be dealing with aspects of human biology which are controversial to-day. It is worth remembering that a good deal which is common-sense in Britain to-day was once a novel and revolutionary hypothesis, and still is so in some primitive communities. It is said that certain peoples recognize no relation between sexual intercourse and the birth of children, but regard conception as solely due to the entry of a spirit into the mother. Others refuse to admit any causes of death except human agency, ascribing what we call natural death to sorcery. In each case we now accept the materialistic explanation without question. (Perhaps I should except "Christian Scientists" who attribute disease to error on the part of the diseased or malicious animal magnetism employed by others!). Nevertheless the fact that we rarely give children a perfectly straightforward account either of birth or death shows that very deep psychological resistances to clear thinking on either subject still exist in our society. Neither I nor my hearers can hope to avoid emotional prejudices when we take up these subjects.

These fundamental facts of human biology are as much part of the common stock of ideas on which we all act as are certain fundamental facts of chemistry or physics. For example, everyone knows that the rapid oxidation of cellulose is an autocatalytic process, in other words, that one can light one piece of wood from another, a very fundamental and revolutionary discovery in its time. Other chemical and physical facts, not so generally known, are applied in industry, others again await application. What are the facts of human biology analogous to these two latter classes?

The most important group of data applied by specialists are these which constitute the medical sciences. Those which are not applied in medicine are, to a very large extent, not applied at all. Either they have no obvious application, or they form the basis of arts such as Eugenics, which, like inter-planetary navigation, are not yet practiced, at any rate in this country, even if their principles are partly understood.

Before I come to my main theme, I must crave your indulgence while I say a few words about the medical profession. The application of science to other branches of life has led to increase in organization. Some of these organizations are capitalistic like the railways or the great industrial combines, others socialistic like the Post Office or Woolwich Arsenal. But though we do not go to an individual artisan for our car or to an individual water-carrier for our water, we still go to an individual doctor for our healing. The largest organizations for medical and surgical treatment are the hospitals, which are neither capitalistic nor in this country socialist, but survivals or imitations of mediaeval foundations. A few large clinics and nursing homes are run as business concerns.

The result is most unfortunate. The patient consults a, doctor who is supposed to understand the whole gamut of human ailments, from broken bones to madness. If poor, he or she may ultimately be admitted to a hospital, but too often after a considerable delay. The middle class patient is treated in his own home or in a nursing home, where conditions are generally far worse than in a hospital. There are generally fewer specialists available, less adequate apparatus and laboratory facilities, and less constant attendance by nurses. Only the very rich secure as satisfactory treatment as the
hospital patient. I speak from experience of both. I have been in a really good nursing home. I have also been in one where the conditions were inferior to those of the better hospitals in Mesopotamia in 1917.

The system is obviously unsatisfactory. Though I should prefer to see a state medical service, I am sure that the middle class patient would be very much better off with a capitalist type of medical organization than at present. He could go to an institution where he would find a team of competent specialists including a radiologist and a bacteriologist, and would very probably be able to avoid the very heavy occasional costs of illness by paying a fixed annual fee.

As medicine becomes more and more a matter of prevention as well as cure, the defects of the existing system show up more clearly. The preventive and prophylactic side of medicine is represented by the medical officers of health, the school medical officers, and a few voluntary institutions such as the Peckham health centre, which are models of what should be; but under a system of individual medical attendance adequate disease prevention is almost impossible, if only because it is far harder to detect latent disease in an apparently healthy person, than to determine the nature of a disease already existing.

If the existing knowledge of human biology and that which is likely to come into existence in the near future were adequately applied, there would, as we shall see, be an enormous demand for experts. It is a very serious question whether they should be members of the medical profession. Again it has been suggested that sufferers from certain incurable diseases should be killed, that persons with hereditary defects should be sterilized and that abortion should be permitted in certain cases where the mother's life is not in danger. If any of these practices are legalized I sincerely hope that they will not be entrusted to the medical profession. The relation of the physician to his patient should always be that of a healer, never of killer, and the whole psychology of that relation would be profoundly altered for the worse if this ever ceased to be the case. This fact was realized by the wise man or men who framed the Hippocratic Oath. If public opinion demands the application of medical technique to such ends as I have suggested, the profession will be well advised to surrender some of their rather jealous guardianship of this technique; rather than extend their functions unduly.

For the same reason I believe that it is desirable that the experts who in the future will be concerned, as I believe they will, with the enforcement of standards of diet, housing, reproduction, and so on, should not be medical men, though they will have to learn much of the science which is now taught only to the medical profession. The alternative would be an hypertrophy of the medical profession such as occurred in the middle ages when the church concerned itself not only with spiritual affairs but with government, education, and handicraft. Such an hypertrophy could only end in disaster. An expert on human biology need not be a doctor, and in many cases should not be, any more than every clerk should be in holy orders.

For as soon as human biology ceases to deal with the individual, it becomes inevitably mixed up with politics. In this lecture I propose to examine some of these repercussions. I shall deal chiefly with the questions connected with human reproduction, the questions of the quantity and quality of our future population. Here I have the advantage that the subject has already been treated by Dean Inge, who preceded me in this lecturership. It is always interesting to study the reactions of an intelligent outsider to scientific thought. But such an outsider is apt to label as scientific, ideas which have but a meagre claim to that title.

Let us begin with the question of numbers. Dean Inge believes that a happy and healthy England would be more sparsely populated than at present, by a population largely engaged in agriculture. This is only true if it is impossible to keep an industrial population healthy and happy. It will be time to conclude that this is impossible when the attempt has been made on scientific lines, and not till then. An urban population living in unplanned houses, and eating an unplanned diet, is bound to be less healthy than a rural population. An urban population which was adequately fed, and had opportunities for sport and country travel might be healthy enough. When I climb Snowdon, as I
have done at least once, without meeting anyone else, I cannot resist the conclusion that our population is ill distributed rather than too large.

Whether I am right or not, it is certain that our population is going to diminish very greatly in the near future. This prediction is based on the statistical methods introduced by Dublin and Lotka in the United States, and by Kuczynski in Europe. Their work has recently been popularized by Charles in "The Twilight of Parenthood." If we have a table of deaths at different ages and children born by mothers of different ages, we can readily make the following calculation. If 1,000 girl babies are subject to these death rates and birth rates, how many daughters will they produce in the course of their lives? In England to-day this figure is about 750. The figure 0.75 is called the net reproduction rate. The population is still increasing because there are a large number of women of child-bearing age, but it will begin to fall within the next ten years. Wherever the net reproduction rate is less than 1, the population is bound to fall. In our own country at least no improvements in hygiene can possibly counteract the tendency. If we take 1,000 girl babies and suppose that none of them dies before the age of 50, while their fertility in each year is unchanged, we get a figure called the gross reproduction rate. This is, of course, higher than the net rate, but in England and Wales it fell below unity in 1927.

Similar figures are available for a number of other countries. The net rate is below unity throughout North-Western Europe, including France and Germany. It is near unity in central Europe, and rapidly dropping towards that figure in Italy and the Balkans. For example, the net reproduction rate in Bulgaria fell from 1.9 in 1903 to 1.3 in 1929, and is probably now very little above unity. In the United States it probably fell below unity in 1927. In the British self-governing dominions it is still slightly above unity, but approaching that figure. The position in the U.S.S.R. and Japan is, entirely different. In 1926-7 the net reproduction rate of the former country was 1.7; that of Japan is also very high, though really adequate figures are lacking. It is of course probable that in both these, countries industrialization will ultimately lower fertility, but there are as yet no clear signs of this tendency.

The political consequences of these facts are interesting. Dean Inge disapproves strongly of Communism, and thinks that England should play an important part in combatting it. But he approves of a trend in population which is rapidly rendering England, and all other capitalist countries save Japan, less and less capable of effective action against the Soviet Union, should such action be desired by those who regard our civilization as superior to that of the Soviets.

Though I do not share all the Dean's views on international politics, I think that a great diminution of our population, while that of other countries is increasing, would intensify the present instability of the international equilibrium. If the population of Australia does not increase much more, while that of Japan does so, it will become increasingly difficult either morally or physically to resist the Japanese claim to immigrate into that continent. I think that it will be generally agreed that, even if a slight diminution in our population is desirable, the catastrophic fall which will occur if the fertility of Englishwomen is still further diminished, is undesirable. I shall consider later what steps should be taken to check this fall.

We next come to the question of quality of population, by which I mean innate quality. Dean Inge makes the surprising remark that "any progress which is not based on an intrinsic advance in human intelligence is very precarious." Of course all progress is precarious, but I have yet to come across any evidence whatsoever that there has been any advance in the intrinsic factors making for intelligence in Europeans during the last 50,000 years. We have no reason to suppose that a hundred babies gathered from Solutrean caves and transported by a time machine into the year1934 would grow up, on the whole, stupider than the rest of us. Progress as far as I can see has been due to the substitution of one type of production by another, and in so far as the new social organization has been stable, the progress has been of a fairly permanent character. Progress and evolution are different processes with different time scales. We are surprised if we can detect evolutionary change in a section of the geological record covering as little as 20,000 years. But the whole of human
progress since the old stone age is comprised in less than this period. It is no doubt desirable that man should evolve in certain directions, but such evolution is a quite different thing from social progress. It may be that there is a limit to the social progress possible without further evolution, but before such a conclusion is proved a good many experiments will have to be made; and the statement that the limit of progress has now been reached need not be taken seriously except as an expression of conservatism in the speaker.

As regards innate human quality three ideals are held up. Certain relatively rare types should be eliminated, certain classes within a given community should be encouraged to perpetuate themselves while others should not. And certain races should be prevented from immigrating into given areas or expelled from them. Curiously enough eugenic organizations rarely include a demand for peace in their programmes, in spite of the fact that modern war leads to the destruction of the fittest members of both sides engaged in it.

Let us first consider the undesirable innate characters which we want to eliminate. Many of them are due to the substitution of one gene for another. That is to say they are inherited in accordance with Mendel's laws. For example "lobster claw," a rare condition in which the hand and foot are reduced to a single pair of digits, is handed down by affected persons to about half their offspring, and never skips a generation. It is due to the substitution of an abnormal gene for one of the genes concerned in limb development. Affected persons have one normal and one abnormal gene of this pair, and hand down each to half their progeny. A gene like this which produces effects when heterozygous, i.e. associated with a normal allelomorph, is said to be dominant. If all affected persons were prevented from breeding, the condition would be wiped out in a generation, save for the very rare cases, probably less than one in a hundred million, where the abnormal gene arises anew by the process called mutation. In this case we should be sacrificing one normal child for each abnormal whose birth was prevented.

Some other dominant characters would not be so easily extinguished. Thus one cause of congenital mental defect is epiloia, or tuberous sclerosis. This is a dominant, but is rarely handed down for more than two generations, as it causes early death as well as mental defect. Unfortunately this adverse natural selection is balanced by mutation. Penrose showed that at least 20% of a series of cases arose in this way. So here sterilization would only reduce the incidence by about 80% even if every case were diagnosed, which is unlikely, and does not always cause mental defect. In only 22% of Penrose's cases had the disease been actually diagnosed in a parent, so probably sterilization would only give a reduction of this order.

Again Huntingdon's chorea is a dominant. This terrible disease begins with involuntary muscular movements, which are the first symptoms of a nervous disease culminating in madness and death. The average age of onset is about 35. By this age most people have already begotten the majority of their children. The sterilization of subjects of this disease under the recent German law, even if carried out very thoroughly, will therefore not abolish it within a measurable time, though it will slightly diminish its incidence. It could only be wiped out by preventing all children of affected persons from breeding, a sacrifice of 3 normal children for each abnormal whose birth was prevented.

Another group of diseases are sex-linked recessives such as haemophilia. This condition is due to a gene carried in the X chromosome, of which women possess two and men only one. A woman carrying one gene for haemophilia is normal but transmits the condition to half her sons. An affected male does not transmit it to his daughters, but it reappears in half their sons. However, it is so fatal that haemophilies rarely marry, and Bulloch and Fildes even doubted whether it was ever transmitted by a male, though I think the evidence for this is very strong. Haemophilies certainly should not beget children, though as they rarely do so, a prohibition would have little eugenic value. They could not be sterilized by operation, as this would often be fatal. X-rays might be used. The only measure which would appreciably diminish the frequency of haemophilia would be the prevention of further child-bearing by healthy women who have had a haemophilic son, and by the sisters of haemophilies. The sterilization of mothers would sacrifice three normal children for each
abnormal, that of sisters seven normals for each abnormal. Such measures would perhaps be justifiable were the population increasing rapidly. I doubt if they would be so at present.

Finally we come to recessive abnormalities. These include many forms of blindness and deafness, and at least two forms of idiocy. The case of juvenile amaurotic idiocy is typical. This is due to the presence in an idiot of two abnormal recessive genes, one contributed by each of two normal but heterozygous parents. When such parents marry, on the average one quarter of their children are affected. No case is recorded in Europe (though there is one in Japan) where an amaurotic idiot has lived long enough to have children. If two grandchildren of the same heterozygous carrier marry, the chance that both will be heterozygous is one sixteenth, whereas the chance that two unrelated persons will carry it is (in the population of Sweden) about one in 15,000. Hence it is not surprising that the condition is very much more frequent among the children of cousins than in the general population. Sjögren found that 15% of the Swedish cases were the children of first cousins, and a further 10% of other relatives. Similarly Usher found that 24 of 79 English cases of retinitis pigmentosa, a disease which causes about 4% of all blindness, were the offspring of first cousins, and 4 more of first cousins once removed.

It would be useless in such cases to sterilize the affected. Very often they do not breed, and when they do their children are generally normal. There is also no prospect of eliminating the recessive genes. Nearly 1% of Swedes are heterozygous for amaurotic idiocy, and probably most normal people carry some deleterious recessive gene.

At present only two eugenic measures are available. One is to discourage the marriage of cousins. The only body that does this is the Roman Catholic church, which is however hostile to other forms of eugenics. The other would be to allow or enforce the sterilization of one partner in a marriage which had produced a recessive at certain time, or to sanction or even compel the dissolution of such marriages.

Deaf mutes present a special problem. Deaf mutism may be congenital or due to infantile ear disease. Congenital deaf mutism is largely due to recessive genes, as appears from the fact that, in different populations, from 21% to 40% of congenital deaf mutes are the progeny of consanguineous marriages. But deaf mutes very frequently marry. Were all deaf mutism due to a single recessive gene the progeny of two congenital deaf mutes would always resemble their parents. Actually several genes are concerned. So most marriages of congenital deaf mutes give normal children. Nevertheless Dahlberg finds that 29% of the children of two congenital deaf mutes are deaf mutes. I think there is a good case for sterilizing the husband in such a case, more especially as it is clear that normal children brought up by two mute parents must be considerably handicapped.

The scope of negative eugenics, as applied to physical defects, seems then to be severely limited. The possible methods include not only prevention of procreation by affected persons, but also by their relatives, besides the discouragement of inbreeding and the dissolution of certain marriages. Actually the prospects are far brighter than this. We know so little of human genetics that only such rough and ready methods are at present available. But if we possessed the same knowledge of human genetics as we do of the genetics of Drosophila or maize, we should be able to say, with very high probability, that such and such children of a sufferer from Huntingdon's chorea has received the gene for it, and should not marry; that some of the brothers of an amaurotic idiot carried the gene for that disease, and others did not. Possibly we could detect the gene for haemophilia in heterozygous women, and so on.

This sort of thing is possible in Drosophila because harmful genes, e.g., for short wings or defective eyes, are carried in the same chromosome with harmless ones such as those for slight abnormalities in bristles or wing veins, which are quite common in wild populations. Such genes are linked, that is to say are handed down together, and the harmless variations thus serve as indices of dangerous recessives.
Quite a number of human differences, for--example those between members of the different blood
groups, and between those who can and cannot taste phenyl-thio-urea, are due to very common
gene substitutions. It would be perfectly practicable to discover a large number more of such genes.
Indeed they were being discovered at a considerable rate by a German worker until political events
put an end to his research. I should estimate the cost of an investigation which would give us a
sufficient background of normal genes for linkage work at between L3,000 and L5,000 provided the
right men were chosen for the work, and a number of families were available through co-operation
with some hospital or authority.

Except with such aid I see little chance of investigating the problem of congenital defect. We
already know that mental deficiency is due to very many causes, and naturally enough. There are
some hundreds of causes of blindness; and the cerebral cortex is a more complicated organ than the
eye, and therefore likely to work badly for a greater variety of reasons.

Of so-called congenital cases of defect some are due to injury at birth, some to infection, especially
syphilitic. Here it is worth noting that chemists are only permitted to sell antiseptics for the
prevention of that disease if no instructions as to their use are sold with them! This curious example
of censorship doubtless accounts for some mental defect. Other types of defect, particularly
"mongolism," are caused by prenatal environment rather than heredity. Of the truly innate types of
mental defect some are due to dominant genes, as shown by their transmission to the offspring,
some to recessive genes, as shown by the frequency of inbreeding among their parents. In most
cases we have no definite information, and shall not until we can distinguish the different causes by
clinical or genetical research. Quite recently Folling found, that 10 out of 430 defectives, and no
normals, excreted phenyl-pyruvic acid. Here the mental defect was probably due to a metabolic
error, and this latter very possibly to a recessive gene.

Now a proportion of mental defectives which different authors place between 5% and over 50%, are
derived from defective parents. Thus if all defectives were prevented from breeding the number of
defectives in the next generation would be reduced by a proportion which I do not personally think
would exceed 20%. The dominant genes concerned would be abolished, but the recessives would
remain. This result would be worth while, but would not abolish mental defect, and would be slight
compared with other equally practicable results, such as the abolition of venereal diseases, which
would also involve some restrictions on liberty.

There are several objections to the policy of wholesale sterilization which has been suggested. The
operation is trivial for men, but for women it is about as serious as that for appendicitis, and there
would inevitably be occasional fatalities. Any attempt to make this operation compulsory or even
alternative to seclusion in an institution would be a violation of the principal of the sanctity of
human life, which underlies so much of our legal practice. Except as a punishment for murder or
treason the law does not permit that people should be killed, though it permits an operation risking
their lives in order to eliminate a graver risk. If a government once violates this principle it is
opening the door to very serious Consequences. Our more intelligent politicians realize very well
that if the government starts killing people, people will sooner or later start killing the government.
Hence it is to be hoped that they will not legalize such operations as salpingectomy on imbecile
women, even if it is done with her consent. The consent of a mental defective is not worth very
much.

Another objection is that we have no adequate criterion of mental defect. The late Professor Trouton
did not learn to read until the age of 12. If he had been an elementary school child he would have
been sent to a special school for defectives. He was so far from being defective that at the age of 17
he discovered the law which bears his name.

Sterilization would not be carried out without class discrimination. Idiocy and imbecility are about
equally common in all classes. Certified feeble-mindedness is commoner among the very poor.
While genuine mental defect may be rarer, it is obvious that it is often not certified among the rich,
although a glance at the press will convince anyone that they include a number of persons who
satisfy the legal criterion of imbecility in that "they are incapable of managing themselves or their affairs."

It is worth pointing out that where mental deficients are sterilized this is done from economic as well as from biological motives. Judge Holden of Yakima, Washington, U.S.A. sentenced John Hill to a sentence of from 6 months to 15 years imprisonment for stealing hams, the sentence being suspended during his good behaviour. He also suggested that Hill should be vasectomized, to which he consented. What follows are the judge's own words:

"Hill, his wife, and five children, are all mentally subnormal, even for their situation in life. For many months the children have been half starved and half clothed ... The case was brought to the attention of the public authorities through the discovery of the theft of the hams, since which time he and his family are partly dependent on public charity, and without the addition of more children to the family, will undoubtedly continue to be more or less of a public charge; with more children the extent of demand on public charity will, be increased."

It did not occur to the judge either that there might be any connection between the starvation of children and their mental dullness, or that there was anything wrong with conditions under which a beet sugar labourer could not earn enough to support five children.

It may be necessary that the richest country in the world should sterilize its citizens as a measure of economy. But at least it is to be hoped that if Britain follows the example of Washington the suggestion will not be made that such action is taken in response to the demands of biologists. Biologists may legitimately demand that a proportion of mental defectives should be prevented from breeding. The demand that they should be sterilized comes from those who consider such a measure to be cheaper than segregation, and to whom this consideration is paramount. But there is I think a real case for legalizing the sterilization of those who desire it, if they carry a sufficiently harmful dominant gene, such as those for some forms of cataract, blue sclerotics with brittle bones, epiloia or lobster claw. Such a measure seems desirable as an addition to our liberties whose effects would be biologically advantageous.

Besides demanding sterilization and similar measures for defectives, many eugenists hold a doctrine which may be stated as follows: "Men and women born into one economic class are constantly passing into a richer one if they possess more innate intelligence than the average of their class, into a poorer one if they possess less. But the poor breed faster than the rich. Hence the innately Stupid breed faster than the innately clever, and the mean innate ability of the population is falling. Before examining the proposed remedies for this situation I must consider whether the fundamental proposition is true:

At first sight it appears obvious, but there are two good reasons to doubt it. In the first place it is clearly flattering to the self-esteem of those who hold it, and therefore suspect. Secondly, if it were true, a system which allotted a number of wives to people who made money would clearly tend to produce a race of great ability, at least in commercial matters. Now this system has been tried, and what is more, tried with an adequate control. In Mohammedan countries during the last twelve centuries followers of the Prophet who have acquired wealth have practiced polygamy, while their poorer co-religionists have had one wife or none. On the other hand Christians and Jews in Mohammedan countries have been on the whole monogamous, even if the rich had some illegitimate children. Hence we should expect that Mohammedans would have acquired greater commercial ability than members of other religions, in fact that a Turk would generally beat a Jew or an Armenian in a commercial deal. This is not the case. Hence I do not regard it as certain that if in England the rich bred faster than the poor our race would acquire greater innate ability, even of that particular kind which leads to a rise in the economic scale.

I wish to suggest that the phrase "innate ability" is meaningless. We cannot say that in all environments A will prove abler than B by any particular test, save in exceptional cases, as when B is a microcephalic idiot. An analogy from agriculture will make my case clear. Put a Jersey cow and
a South Africa scrub cow in an English meadow. The Jersey will give far more milk. Put them on
the veldt, and the Jersey will give less milk. Indeed she will probably die. The Jersey has been
selected, not for high milk yield in all environments, but for a yield which varies more than that of
the primitive cow in response to environment.

A number of writers on eugenics have dealt with the so-called "social problem group," men and
women who are petty criminals, unemployed even in times of prosperity, more fertile than the
average, and on the whole endogamous. There is evidence that their behaviour is partly due to
inherited dispositions, and it is assumed that they would be socially inadequate in other
environments, as they are in the slums. I think this far from certain. They include some real
defectives, but the rest, for all that anyone knows, may be like the Jersey cows, on the veldt,
yielding little of value in their actual environment, but possibly capable of better things if they got
out of it than men and women who are more contented with social conditions as they exist in the
slums. It is only when people have failed in a favourable environment such as we may hope to see
throughout Britain in the future that they can be regarded as probably unsuitable parents of future
generations. Differences within a social class are far more likely to be heritable than differences
between members of distinct classes.

I know that most writers on eugenics disagree with me, and I will briefly examine the consequences
to be drawn from the theory that as regards human achievement the effects of nature and nurture are
additive, even though they are not so as regards the yield of cattle or wheat.

If the well-to-do are innately abler than the poor it is desirable that they should breed quicker. They
appear to breed more slowly for several reasons. They are more cautious, have greater knowledge
of, and opportunity for, birth control, and carry more genes making for low fertility. This last
characteristic is due to the fact that low fertility is inherited, and makes for economic success, as is
obvious if we compare the possibilities either of saving money open to a man with two children,
and a man with ten. In this country it has been specially stressed by R. A. Fisher. In view of our
already inadequate birth rate no proposal tending to reduce the existing fertility of any classes not
definitely defective can be seriously entertained. A new system of family allowances would have in
Fisher's view three distinct advantages.

In the first place it would check the coming fall in our population. In the second it would act most
sharply on the fertility of those who now limit their families on economic grounds, and are regarded
by most eugenists as possessed of better innate endowments than those who breed more freely. And
thirdly, by checking the social promotion of infertility as such, it would end the present sterilization
of ability. For, according to Fisher's argument, infertility and ability equally lead to a social rise, and
hence, as people generally marry within their own social class, genes making for ability and
infertility are associated in the same families, and thus the genes making for ability tend to
disappear.

There is, however, an argument for family allowances which appears to me very much more cogent.
In the last twenty years we have, for the first time, arrived at definite criteria of a satisfactory diet
for human beings. We know that a very great deal of our existing physical defects are due to
qualitative as well as quantitative under-nourishment.

Qualitative under-nourishment is not confined to the poor, But it is certainly far commoner among
the poor than the rich, And in a family with a sufficiently small income it is impossible to avoid it.
There is surprisingly little controversy as to the minimum cost of an adequate diet for children
under English urban conditions. The British Medical Association's Committee find that this rises
with age from 2/8 to 5/5 per week. Professor Bowley's standard including less milk, rises from 1/10
to 4/8.

It is at any rate clear that the 2/- per week allowed for the child of an unemployed man for all
purposes is entirely inadequate, and that if this sum were raised to 5/- the unemployed with a family
of four or five would receive a larger income than many employed men with similar families.
It is not for a biologist to suggest how this situation should be remedied. But if it is not remedied then the research of the last few years on dietetics has been largely useless, and there appears to be little point in continuing it. Clearly the action of the Government in lowering the price of milk to school children is an example of one possible method, which if properly carried out will tend to canalize the demand for foodstuffs into channels approved by biochemists. It is a compromise between allowances and rationing.

But though it is a great step forward it is very far from adequate. A definite standard of diet is available, and no biologist should be satisfied until it is reached. It is worth noting, by contrast, that no similar standards can be given as regards housing or clothing. A biologist may demand the abolition of slums, but he cannot say what constitutes a slum, while he can say what constitutes an inadequate diet. In the future scientific standards of housing may be attainable, but they are not as yet.

I have tried to show that three different arguments may be brought forward for some form of family endowment. In the first place an adequate diet is now as much part of preventive medicine as an adequate water supply. Secondly, our population is likely to decline rather rapidly unless the present economic incentives to family limitation are removed. Thirdly, such a measure would check the association of innate ability with infertility which is thought by many eugenists to exist. For the last two purposes family allowances would have to be roughly proportional to the family income. Fisher regards 12% per child as adequate; other authors would give a higher figure.

It is not for me to say whether adequate family endowment is present economic system. There are good reasons to doubt it. If our rulers tell us that it is impossible under capitalism, then we had better try socialism. However, it can also be argued that an assured effective demand for a certain minimum would tend to stabilize capitalism, and that the existence of even our present biologically inadequate minimum in Britain has stabilized it.

Whichever of these alternatives is true, I am certain that as biologists begin to deal with human problems they will increasingly demand a minimum dietary for the whole population, and a system of family endowment which will counteract the existing trends in our population.

I have not had time to deal with the racial question. A good case can be made out for discouraging immigration of negroes into Europe, or of Europeans into tropical Africa, since in each case the immigrants are ill adapted. Unfortunately as the result of political factors there are far greater difficulties in migration between England and Denmark than between England and Nigeria. No such cases can be made as between the different genetical types (I hesitate to use the word "races") who have lived in Europe for many centuries.

There is, of course, a strong case against the admission of persons of whatever race who are physically or mentally below the average. On the other hand the opportunity has arisen, as the result of recent political disturbances in Europe; of admitting to British citizenship exiles of proved intellectual ability. Every eugenist should be prepared to recommend the admission to British citizenship of such exiles, provided that they attain a sufficiently high standard.

I fear that I have said little that is novel, nor have I offered any particular panacea. The application of the data of human biology to politics and ethics will probably be more complex than that of the data of physics to industry. It is very important, if the whole science is not to be discredited, that premature steps should not be made, and that biology should not be harnessed to the car of any political party. For the latter reason I have here suppressed many of my own views, for example the opinion that our existing society is biologically unstable, and have tried rather to stress those opinions which enjoy a sufficiently general support to render them worthy of consideration not only by biologists, but by politicians of whatever outlook.
PREFACE

THIS BOOK IS BASED UPON THE MUIRHEAD lectures on political philosophy delivered in the University of Birmingham in January and February 1938. I have expanded them to deal more fully with matters of detail. They are primarily addressed to scientific workers and students, in the belief that Marxism will prove valuable to them in their scientific work, as it has to me in my own. But in view of the general importance of the subject I hope to interest a somewhat wider audience.
I have tried to apply Marxism to the scientific problems of my own day, as Engels did over many years, and Lenin in 1908. I do not doubt that I have made mistakes. A Marxist must not be too afraid of making mistakes.

Such an attempt as mine inevitably invites one of two criticisms. If one confines oneself to well-established scientific facts, one is told that it is easy to apply Marxism after the event, and that with sufficient ingenuity one can find a quotation from Marx or Engels which is apposite to any piece of recent scientific work. If, on the other hand, one ventures into speculation one is certain to be wrong on points of detail, if not on more fundamental matters. Nevertheless, I think it is worthwhile to demonstrate the kind of speculations into which Marxism leads a scientist.

For an acceptance of this philosophy inevitably induces novel types of action and thought. This must be my apology for parts of Chapter 5 which some readers will consider an excrescence on an otherwise useful book.

I have tried to cover a very wide field, and am fully aware that I have done so both unevenly and superficially. I hope, however, that I may stimulate others to fill in the gaps in my exposition and to correct it where necessary. An adequate Marxist interpretation of science can only arise in an atmosphere of vigorous controversy, and I wish to make it absolutely clear that I expect to be criticized. But I hope that the criticism to which I am subjected from Marxist writers will be constructive.

I have used the following abbreviations in my citations:


C. Capital, Karl Marx. English translation by Moore and Aveling. (Modern Library, New York.)

O. F. The Origin of the Family, Private Property, and the State, Frederick Engels, 1884. English translation by Ernest Untermann. (Kerr, Chicago.)


I hope that many of my readers will be induced to study these books.

SOME MARXIST PRINCIPLES

I OWE TWO APOLOGIES TO MY AUDIENCE AND readers. In the first place I am not primarily a philosopher; but when I am asked to lecture on political philosophy, I can choose no more appropriate subject than the most political of all philosophies, that of Marx. The second apology is more serious. I am by no means qualified to speak on Marxism. I have only been a Marxist for about a year. I have not yet read all the relevant literature, although I had of course read much of it before I became a Marxist. The object of these lectures will not only be to enlighten my audience, but to clarify my own thoughts. It will be remembered that Socrates described himself as the midwife who helped the unborn thoughts of others into the world. I will ask my hearers and readers to function in that capacity in my own case.

Now we must ask ourselves at once, why is Marxism important? I think I may presume that the majority of my audience and a considerable fraction of my readers are hostile to it. Why should they worry about it? One reason is because it is a philosophy of very great practical importance, a philosophy which is not less important if one decides that it is entirely false. It makes a considerable difference to the conduct of its adherents. I believe that one could spend a week (in vacation time, at any rate) with the average academic philosopher without discovering whether he was an idealist or
a realist, but I do not think that one could spend a day with a Marxist without discovering his tenets. There are two other important philosophies which issue in action to a very considerable extent. The first is the scholastic philosophy, whose greatest exponent was St. Thomas Aquinas. That philosophy represents not merely the opinions of a few people, or even of the whole body of priests and monks, but the practice of the great medieval civilization. That philosophy is still active in guiding the activity of the Roman Catholic Church. It is, therefore, deserving of study whether we adhere or object to it, simply because the Catholic Church is a very important institution. The second of these practically important philosophies is what a century or two ago was called natural philosophy, and is now called science. It is, however, limited in its scope. It has certainly been successful in some fields. In others it has had less application. It has undoubtedly transformed the world.

Now Marxism claims to apply scientific method in the field of politics and economics, and to predict and to enable us to control the transformation of the world still further. Because it extends scientific method into the human field it throws a new light on science, as a human activity depending both on contemporary social and economic conditions and also on certain very general laws of human thought. It further lays down some principles which are said to hold throughout nature, as well as applying to human activities. We shall have to investigate these claims in what follows.

Above all, I believe that I am justified in giving these lectures because of the very remarkable misapprehensions which undoubtedly exist in many quarters regarding the Marxist philosophy. A good many people do not, I think, even know of its existence. They know nothing of the theoretical side of Marx's work, except, perhaps, the doctrine of surplus value. If they hear that Marxism is materialism, they think materialism is the theory that man is a machine, or the denial of the existence of mind.

Now, until 1917, it might have been possible to dismiss Marxism as the doctrine of a small set of cranks, no more important than the doctrines of Bakunin, Sorel, or other revolutionary theorists. This was particularly so in England, where Marxism was largely ignored both in academic and political circles, whereas on the continent of Europe it was at least considered worthy of criticism. You will remember, however, one of the definitions of a crank, covering both the human and mechanical kinds, as "A little thing that makes revolutions"! It is now impossible to doubt the importance of Marxism, because Marxism was the philosophy of Lenin. It is very difficult to deny that Lenin was the greatest man of his time. Not that this admission need imply agreement with him. It is perfectly possible, without being a Mohammedan, to admit that Mohammed was the greatest man of his time. The philosophy of a man who has had so great and important an influence on world history as Lenin is undoubtedly worthy of investigation.

You will remember that Plato said that the ideal state was only possible when a philosopher became a king. Lenin was, amongst other things, a philosopher. We shall have to examine some of his philosophical views later on. He became, if not a king or even a dictator, the most important man, and the ideological leader, of a community covering most of the former Russian Empire. And that community is still largely guided by the principles which he laid down. The Soviet Union is certainly not the ideal state, for one reason because Marxists are not interested in ideal states, but in actual or possible states. Lenin's philosophy is today very much alive, both in the Soviet Union, and among communists and other Marxists who are not members of the communist party, outside the Soviet Union. The intensity of the interest taken in philosophy in the Soviet Union may be gauged by the statement, which I believe to be true, that in 1936, one hundred thousand copies of a translation of certain of Kant's works (I cannot believe they were his complete works!) were printed, and the whole lot sold out. Philosophy is at any rate a subject of very general interest in the U.S.S.R., and one result of communist propaganda in Britain has been a revival of interest in philosophy.

Such are some of the reasons why even those who are convinced of the truth of some other
philosophy, and of the rightness of some other political practice, should be willing to make at least a superficial study of Marxism. My own reason for delivering these lectures is a different one. I think that Marxism is true.

Now, what is Marxism? Plekhanov, a Russian Marxist and predecessor of Lenin, began his book, *Fundamental Problems of Marxism,* with the statement: "Marxism is a complete theoretical system." That is approximately true of the philosophy of Aristotle, St. Thomas, Spinoza, or Hegel. Clearly it is not true of the philosophy of Socrates. It is also untrue of Marxism. Marxism is not complete, not a system, and only in the second place theoretical. It is not complete because it is alive and growing, and above all because it lays no claim to finality. The most that a Marxist can say for Marxism is that it is the best and truest philosophy that could have been produced under the social conditions of the mid-nineteenth century. It is not primarily a system, but a method. As Marx said in the Eleventh Thesis on Feuerbach: [F., p. 75] "The philosophers have only interpreted the world in various ways: the point is to change it." Like Descartes, he regarded his philosophy as primarily a method, and although theory is essential in Marxism, Marx proclaimed the primacy of practice over theory.

This is not, of course, to say that Marxism does not include a great deal of systematic theory, which is to a large extent the fruit of the method. But the details of Marxist theory, like those of the theories of natural science, are the result of applying the method to concrete situations. And the theory which exists was built up with far more attention to observed facts and far less "pure thought" than the great philosophies of the past.

A few words are necessary about the historical origins and sources of Marxism. Marx was born in 1818 at Trier, in south-western Germany; his father was a Jewish lawyer who came to Protestantism when Karl was six years old. His colleague, Friedrich Engels, to whom Marxism owes so much, was born in 1820 at Barmen, in Rhineland. His father was a German manufacturer. Both studied philosophy. Marx got his Doctorate for a thesis on the philosophy of Epicurus; they both became left-wing Hegelians, and later followers of Feuerbach. Marx wanted to become a philosopher, and it is likely that had he become a professor he would have been a good deal more innocuous to the social system in which he lived than actually proved to be the case. However, the Prussian Government dismissed a number of people like Feuerbach and Bauer, whose philosophical and political views, though radical, were very much milder than Marx's views later became. Marx took to journalism. He was one of the founders of the radical *Rheinische Zeitung* in 1842. When it was suppressed in 1843, he went to Paris. Meanwhile, Engels had gone to Manchester in 1842, where he worked as a cotton broker and studied the life of the working people. His book, *The Condition of the Working Class in England,* was published in 1845.

In 1844, Marx and Engels met in Paris, and became lifelong friends. They came under the influence of French revolutionary theorists like Proudhon, and became Socialists. In 1845, at the instance of the Prussian Government, Marx was forced to leave Paris, and went to Brussels. By this time their views had been considerably clarified. They were in disagreement with Proudhon and other French leaders, and their economic and political outlooks were stated in the "Communist Manifesto," which Engels drafted, and which was published in 1847.

In 1848, both took part in the revolution in Germany, Marx as a journalist, Engels as a soldier. From 1849 onward, they lived most of their lives in England until Marx died in 1883 and Engels in 1895. Marx lived in London, Engels in Manchester until 1871, when he, too, came to London.

Apart from their political work such as that involved in founding the International Working Men's Association, later known as the First International, they wrote on a very large scale during those years. Marx's most important book was, of course, *Das Kapital,* but in discussing the relation of Marxism to science we shall mainly be concerned with the views expressed by Engels. His most important books for our purpose are, *Herr Eugen Dühring's Revolution in Science,* written in 1878, and popularly known as *Anti-Dühring,* and a smaller book called *Ludwig Feuerbach and the Outcome of Classical German Philosophy,* written in 1888. Finally, we have a large number of
manuscript notes of Engels, which although never published in book form, have appeared in the Marx-Engels Archiv, under the title, "Dialektik and Natur." Anti-Duhring and Feuerbach are both polemical works, and most people find them easy to read. But they are somewhat of a puzzle for an ordinary philosophical student, for a number of reasons. It is important to remember that Duhring, whose writings Engels analyzed with considerable sarcasm, was a Socialist and a materialist, with whom he had enough in common to furnish a real basis of argument. He attacked him with considerable vehemence on the points on which they differed.

Again, Engels professed himself a disciple of Feuerbach, but was critical of his opinions in a number of respects. Similarly, his joint work with Marx, The Holy Family, was directed against Bruno Bauer, with whom they were in a considerable measure of agreement, and the Poverty of Philosophy was directed against Proudhon. It is a characteristic of all these books that they are written, not against open enemies, but against persons with whom the authors had a good deal in common. This makes them difficult reading for one who is accustomed to the average philosophical work, which is addressed to the whole world, so to speak, and not to a group with which the author has only a limited number of bones to pick.

Why, it may be asked, should Engels not have attacked such contemporaries as Comte, Mill, Spencer, or Green, from whom he differed on almost all points? Perhaps the answer is as follows. It was obvious that such philosophies as these would become obsolete in a relatively short time. Many of the political and economic theories of Mill and Spencer are simply irrelevant to modern conditions. On the other hand, the views of Duhring and Feuerbach are held by a good many modern Socialists. Engels attacked "right" theories, not in their crude form, but in their most dangerous form. In fact, he chose not the easiest, but the most difficult antagonists.

Lenin's only important philosophical work is called Materialism and Empirio-Criticism. It was published in 1908 and was directed mainly against Bogdanov, Lunacharsky, and others who claimed to be Marxists. Lunacharsky later became one of Lenin's colleagues in the Government of the U.S.S.R. At first reading, Lenin's book might seem to be an attempt to impose a formal, narrow Marxist orthodoxy. Actually he is undoubtedly justified, when Bogdanov claims to be a Marxist, in quoting passages from Marx which disagree with Bogdanov. The whole book is a book characteristic of a fighter. His attacks are mainly directed against compromisers, whether within the Marxist movement, like Bogdanov and Lunacharsky, or outside it, like Mach and Avenarius. His opinion was that "non-partisans in philosophy are just as muddle-headed as in politics." On the other hand he recognized and admired clear thinking wherever he found it, and in consequence was often extremely polite to his out and out opponents, like James Ward, to whom he refers in the following sentence, among others: "The question, as put by this frank and consistent spiritualist is remarkably clear and to the point." Similarly, Karl Pearson is described as "this conscientious and honest enemy of materialism." Besides this, some short but most important manuscript notes by Lenin on philosophical problems have been published.

In these lectures, we shall mainly be concerned with the relationship of Marxism to science, as developed by Engels in Feuerbach and Anti-Duhring, and by Lenin. Lenin's welcome to the new developments in physics, such as radioactivity and electrons, is particularly interesting as showing the relation of Marxism to discoveries which have been supposed to disprove its basic principles. However, Engels is the chief source, although he states expressly that most of the leading principles in his work derived from Marx.

Now a student of academic philosophy who takes up a study of Marxism will at first be disappointed. A great many questions are left unanswered, for two different reasons. Some were shown to be improperly put, and it was sufficient to demonstrate the historical reasons why they had been asked in the past. Others could not be answered on the existing data. Thus the relation between brain and mind is not in principle an insoluble problem; but it cannot be solved, except in the most summary manner, until we know a very great deal more, particularly about the brain. Marxism is not concerned mainly with being, but with becoming. It claims to enable us to understand change
and development of all kinds, not only political and economic change and development, and by understanding to influence and to control them.

Most philosophers have treated time and change as more or less illusory, though since Hegel's day they are more often taken seriously. An attempt is made to find a timeless being behind this changeable world. That is conspicuously so in the philosophy of Plato. It is worth pointing out that Christianity differs from most of the academic philosophies in ascribing a supreme importance to a number of events in time--the Creation, the Fall, the Redemption of Mankind, and the Last Judgment. That was particularly so in primitive Christianity; and as it ceased to be a revolutionary religion, certain theologians tried to make its theory more and more static. In the first centuries of Christianity, theology was considerably influenced by the neo-Platonists, and in our own day we find such philosophers as Dean Inge trying to minimize the temporal side of theology and to exalt the timeless side. It is not, of course, a mere coincidence that their political views are usually reactionary.

While Marxism makes what at the very least must be admitted to be an ambitious attempt to solve the problems of becoming, it has very little to say concerning the problems of being raised in the classical philosophies. It dismisses many of them as illusory problems which have arisen through unclear thinking. It postulates nothing behind matter, and therefore dismisses metaphysics. It certainly postulates an inexhaustible supply of properties of matter, but no more than that.

In the remainder of this chapter, I shall try to summarize some of the principles of Marxism, though mainly outside the economic field. I shall only deal in the most summary way with Marx's economic and political theories in the last chapter; and as I am not an economist, I do not pretend that my treatment will be either novel or authoritative. In the first place, we have the principle of the unity of theory and practice, with the primacy of practice. Let me quote one of Marx's theses on Feuerbach:

"The question whether objective truth can be attributed to human thinking is not a question of theory but is a practical question. In practice man must prove the truth, i.e. the reality and power, the 'this-sidedness' of his thinking. The dispute over the reality or nonreality of thinking which is isolated from practice is a purely scholastic question."

Again, Engels, in writing of astronomy, pointed out that in its early days, the Copernican hypothesis was only one of a number of theories, each of which would explain the facts with sufficient accuracy. It was only when, on the basis of Newton's theory of gravitation it was possible to predict such events as the finding of the planet Neptune and the return of Halley's Comet, that it could be taken as proved. All this is a commonplace for modern scientific theory, but it was by no means commonplace ninety years ago.

So far we may say that Marxism anticipates pragmatism, although it differs from pragmatism in almost all other respects, notably in its consistent emphasis on the changing of the world, and above all in its belief that there is a real world, and that absolute truth, if never reached, can be continually approached.

A second Marxist principle is materialism. This word has been used in a very large number of senses, and it is important to realize just what Marx meant by the term. Engels wrote [F., p. 31] as follows:

"The question of the relation of thinking to being, the relation of spirit to nature--the paramount question of the whole of philosophy--has, no less than all religion, its roots in the narrow-minded and ignorant notions of savagery. But this question could for the first time be put forward in its whole acuteness, could achieve its full significance, only after European society had awakened from the long hibernation of the Christian Middle Ages. The question of the position of thinking in relation to being, a question which, by the way, had played a great part also in the scholasticism of the Middle Ages, the question: which is primary, spirit or nature--that question, in relation to the Church, was sharpened into this: 'Did God create the world or has the world been in existence
"eternally?"

"The answers which the philosophers gave to this question split them into two great camps. Those who asserted the primacy of spirit to nature and, therefore, in the last instance, assumed world creation in some form or another--(and among the philosophers, Hegel, for example, this creation often becomes still more intricate and impossible than in Christianity)--comprised the camp of idealism. The others, who regarded nature as primary, belong to the various schools of materialism.

"These two expressions, idealism and materialism, primarily signify nothing more than this; and here also they are not used in any other sense."

You will notice the emphasis which is laid on temporal priority rather than on logical priority. This is characteristic of a philosophical system which takes historical fact extremely seriously.

Now that definition of materialism is not accepted by many people. For example, my late father, J. S. Haldane, [Materialism, p. 5. (London, 1932) wrote as follows:

"Materialism may be defined as the belief that physico-chemical realism, or the assumption that the representation of our surrounding universe by the physical sciences in their traditional form corresponds to reality, can be extended so as to cover, not only the phenomena of life, but also those of conscious behaviour."

If we compare this with what Lenin wrote, we shall see that J. S. Haldane's view, so far at least as it is expressed in that passage, is not in conflict with Marxism. Lenin's words are:

"It is, of course, totally absurd that materialism should maintain the 'lesser' reality of consciousness or should necessarily adhere to a 'mechanistic world-picture' of matter in motion and not an electromagnetic, or even some immeasurably more complicated one." [M.E., p. 238]

Again, in another place, Lenin wrote:

"For the sole 'property' of matter--with the recognition of which materialism is vitally concerned--is the property of being objective reality, of existing outside of our cognition. ... The recognition of immutable elements, 'of the immutable substance of things,' is not materialism, but is metaphysical, anti-dialectical materialism." [M.E., p. 220]

It is clear, therefore, that what Marxism calls materialism is something a good deal less mechanical than the materialism of the French eighteenth-century philosophers. It is worth noting that although my late father was a strong opponent of materialism, his book, The Sciences and Philosophy, was recommended by a Moscow radio commentator as a very good introduction to dialectical materialism, although far from being Marxist.

Again, Lenin's attitude to idealism, although hostile, was not completely negative:

"Philosophical idealism is nonsense only from the standpoint of a crude, simple, and metaphysical materialism. On the contrary, from the standpoint of dialectical materialism philosophical idealism is a one-sided, exaggerated, swollen development (Dietzgen) of one of the characteristic aspects or limits of knowledge into a deified absolute, into something dissevered from matter, from nature." [M.E., p. 327 (manuscript notes)]

Why, then, many people ask, should you not drop this word "materialism" which has come to signify addiction to large dinners and expensive motor cars, and call it "realism" or something less challenging? The answer is that Marxism insists on the priority of matter, and that it is a fighting philosophy. Marxists must on occasion deal very vigorously with idealists. Today, for example, it is necessary to combat the propaganda of those pacifists who believe the world can be saved from war by goodwill acting, as it were, in a vacuum, and with the anarchists, who think that it is sufficient to destroy the existing State organizations, and human nature is good enough to do the rest.

The materialism of Marxists is called dialectical materialism, for a reason which will be explained later. Dialectical materialism as applied to human history is called historical materialism. This is the
aspect of Marxist philosophy which is probably most familiar to British readers. But it is only one aspect, and is not that with which we shall be mainly concerned in this book. The nature of the materialistic interpretation of history will be made clear by two quotations from Engels:

"The new facts made imperative a new examination of all past history, and then it was seen that all past history was the history of class struggles, that these warring classes of society are always the product of modes of production and exchange, in a word, of the economic conditions of their time; that therefore the economic structure of society always forms the real basis from which, in the last analysis, is to be explained the whole superstructure of legal and political institutions, as well as of the religious, philosophical, and other conceptions of each historical period. Now idealism was driven from its last refuge, the philosophy of history; now a materialistic conception of history was propounded, and the way found to explain man's consciousness by his being, instead of, as heretofore, his being by his consciousness." [A.D., p. 32]

Again, in another passage he says: [F., p. 62]

"In modern history at least it is therefore proved that all political struggles are class struggles, and all class struggles for emancipation in the last resort, despite their necessarily political form (for every class struggle is a political struggle), turn ultimately on the question of economic emancipation. Therefore, here at least, the state, the political order, is the subordinate, and civil society--the realm of economic relations--the decisive element. The traditional conception, to which Hegel, too, pays homage, saw in the State the determining element, and in civil society the element determined by it. Appearances correspond to this. As all the driving forces of the actions of any individual person must pass through his brain, and transform themselves into motives of his will in order to set him into action, so also all the needs of civil society--no matter which class happens to be the ruling one--must pass through the will of the State in order to secure general validity in the form of laws. That is the formal aspect of the matter--the one which is self-evident. The question arises, however, what is the content of this merely formal will of the individual as well as of the State--and whence is this content derived? Why is just this intended and not something else? If we enquire into this we discover that in modern history the will of the State is, on the whole, determined by the changing needs of civil society, by the supremacy of this or that class, in the last resort, by the development of the productive forces and relations of exchange."

The detailed economic theories of Marxism lie outside the scope of this book, as does the description of Marxist practice in the present class struggle.

Dialectical materialism is founded on Hegelian dialectic. It had long been realized that matter on the whole behaves intelligibly, conforming to the laws of logic and arithmetic. The question arose whether our reason mirrors the behaviour of matter, or whether on the other hand, matter mirrors the behaviour of mind. Kant's view was somewhere intermediate, perhaps leaning to the idealist side.

Hegel laid down, especially in his *Logic and Phenomenology of Mind*, a number of principles of thought going beyond those laid down by Aristotle and taught as formal logic, principles which had been more or less recognized for centuries, but never so clearly formulated. These principles were called dialectical principles. He said that nature conformed to them. According to Hegel the logical categories exist eternally; the world is a mere exemplification of these logical categories in space and time. Feuerbach, Marx, and Engels believed that the principles were exemplified in nature before they governed thought. According to Marx, the ideal is nothing but the material world reflected by the human mind, and translated into forms of "thought. Hegel is standing on his head. Our business is to put him on his feet. Engels treated the Hegelian dialectic as expressing primarily the properties of matter, and only secondarily the laws of thought. He held that the principles which Hegel had worked out in the realm of thought also applied to material events, not only in the social field, but in the fields of astronomy, physics, biology, and so on.

In what follows I propose to give a sketch of the dialectic so brief and abstract as to be almost a
caricature. I shall pass over many of its essential features, and attempt to summarize a few of its main principles. Such a presentation lays itself open to a severe criticism. The dialectic, which is a unity, appears as a collection of rules of thumb, one or other of which should be applied wherever possible. Such a point of view would, I am sure, be dispelled by a reading of Marx, Engels, and Lenin, or of a more modern exposition such as Jackson's Dialectics. I hope, indeed that the following chapters may serve to dispel it. If not, the fault is my own, not that of Marx, Engels, and Lenin.

What are these dialectical principles? One of them is the principle of the unity of opposites. For example, if I say, "John Smith is a man," I am asserting the identity in a certain context of a particular, John Smith, and the universal, man. This identity has led philosophers into very great difficulties for the last 2,300 years. Again, I say that the wood of which this table is made is hard, or it would not support things, and soft, or it could not be cut. Two opposite qualities are united. Before such assertions, we have two alternatives; we may say, as Plato said, that matter is something self-contradictory, it is and is not. Universals are real, but matter is unreal.

Or we may say with Engels that matter unites these opposites. This means that matter is some thing very much richer and more complicated than the mechanistic materialists had ever dreamed.

Two remarks may be made on this principle. Lenin wrote that the unity of opposites is something conditional and temporary. Gas has no hardness, in the sense that it will put up no permanent resistance to division. On the other hand, it is probable that an electron is absolutely hard in the sense of being completely indivisible.

At any stage in the development of science we can undoubtedly explain away contradictions which puzzled our ancestors. For example, today, instead of saying, like Plato, that a table is both hard and soft, we can ascertain by a number of measurements the degree of hardness of the wood, its breaking strain, and so on.

There are a number of things which were Paradoxical to Plato and are not to us. On the other hand, in our own time new contradictions have appeared which seem just as trying to us as contradictions which we find trivial appeared to Plato. For example, electrons have apparently at the same time properties which compel us to regard them as particles, and other properties which can be explained if they are systems of waves. Two thousand years from now, these difficulties may seem very elementary indeed, but I think that our descendants will probably still be finding opposites embodied in matter which they will find difficult to unify.

The second principle is the passage of quantity into quality, and conversely. This phrase is taken from Hegel, but a much more satisfactory account of what is meant by it is given by Marx [C.(I), p. 337] in Capital.

"Here, as in natural science, is verified the correctness of the law discovered by Hegel in his 'logic' that merely quantitative changes beyond a certain point pass into qualitative differences."

A classical example of this is the boiling or freezing of water, but any other change of phase in physical chemistry may be taken as an example. At the boiling point of water some of its measurable qualities show an abrupt break. The volume, which has been going up steadily but slowly, shoots up enormously. Other properties disappear; for example, the capacity for dissolving solutes and that of ionizing salts.

The principle is, of course, absolutely fundamental in physiology. A hundred years ago it was commonly said that carbon dioxide was a poison, because a man died if he breathed pure carbon dioxide. Then J. S. Haldane found that a certain amount of this substance was essential for life. The normal amount in the blood corresponds to a pressure of about 5 per cent of an atmosphere. If this is either doubled or halved serious symptoms arise. In fact, too much of it is a poison, but a certain amount is a necessity.

It is equally fundamental in such ethical systems as that of Aristotle, who pointed out that the
difference between good and evil was largely quantitative. Thus the coward took too few risks, the rash man too many, and the brave man the right number. It is even familiar in law, where for example, three or more people can make a riot, but one or two cannot.

In modern physics it is familiar under the name quantization. Not only mass, but energy, can only be transferred from one system to another (at least in certain cases) in definite quantities. We shall deal with his matter in more detail in Chapter 3. It may well be that quantum phenomena are the most fundamental and primitive expression of this principle, and that the other examples of it will ultimately be explicable a basis of quantum theory.

Now according to the view of matter which was first clearly formulated by Locke, though it goes back to Descartes and Democritus, the quantitative aspect of matter is real, whilst of its qualities are illusory. Thus what we call colours and tones are "really" only vibration frequencies. For Marxists both quantity and quality are properties of the real world.

The converse transformation of quality into quantity is exemplified when a symphony is recorded on a sound-track. Since our knowledge of the external world depends on the frequencies with which nervous impulses reach our brains and spinal columns along a million or two nerve fibres, and not on qualitative differences in these impulses, this transformation, and the reverse transformation of quantity into quality which takes place in our brains, play a fundamental part in our knowledge of the world.

The social applications of the principle are important. They have been given by Marx in a number of places, and it is worth while pointing out that laws holding right through one state of society may become meaningless in another. Social change may be discontinuous, as in the case of water to steam at atmospheric pressure, or continuous, as in the case of the passage from water to steam at pressures higher than the critical pressure. Thus slavery came to an abrupt and violent end in the United States, but faded out gradually in the late Roman Empire.

A third principle, which is perhaps the most important, is what is called the negation of the negation. Let me give a simple example. I learn to drive a motor-car, and among other things to steer it. Then I drive a little faster than usual, and skid. Skidding is the negation of steering. After skidding a number of times, I learn to control a skid in the direction which I desire. That is a passage to a higher level of motor driving. It is a passage which some drivers never make. London bus drivers, who have to learn to drive in pools of oil, are compelled to make it, and the controlled skid is part of the technique of every racing motorist. I take that example from familiar practice. Examples in physics and biology will follow later on.

One of Marx's examples from economics is interesting as showing how he applied this idea in the economic field. First of all, he describes medieval English industry, in which the workers owned the means of production, their own tools; and in some cases, their own land; but he was particularly concerned with handicraft production. Then, with the development of industry in the early stages of capitalism, the immediate producers were expropriated, ceasing to own their means of production, either forcibly, as through the enclosures of the land, or more generally by the competition of far more efficient industry based on division of labour and on capital. The hand-looms were killed by the factories. This process was the negation of the ownership by the workers of their means of production. But Marx claims that this process is now being negated. In the present stage of capitalism, capital is negating itself. [C. (I), p. 836]

"That which is now to be expropriated is no longer the labourer working for himself, but the capitalist exploiting many labourers. This expropriation is accomplished by the action of the immanent laws of capitalist production itself, by the centralization of capital. One capitalist always kills many. Hand in hand with this centralization, or this expropriation of many capitalists by few, develop, on an ever extending scale, the co-operative form of the labour process, the conscious technical application of science, the methodical cultivation of the soil, the transformation of the instruments of labour into instruments of labour only usable in common, the economizing of
all means of production by their use as the means of production of combined socialized labour. Along with the constantly diminishing number of the magnates of capital, who usurp and monopolize all advantages of this process of transformation, grows the mass of misery, oppression, slavery, degradation, exploitation; but with this too grows the revolt of the working class, a class always increasing in number, and disciplined, united, organized by the very mechanism of the process of capitalist production itself. The monopoly of capital becomes a fetter upon the mode of production, which has sprung up and flourished along with, and under it. Centralization of the means of production and socialization of labour at last reach a point where they become incompatible with their capitalist integument. This integument is burst asunder. The knell of capitalistic private property sounds. The expropriators are expropriated."

That is the way in which Marx conceived of the development of capitalism, its self-destruction, and the coming of socialism.

Now the negation of the negation was regarded by Marx as the main source of progress and of novelty. A great many philosophers, for example, Lloyd Morgan and Smuts, have recently been interested in what they call the emergence of novelty.

Lenin wrote:

"Two fundamental (or is it the two possible? or is it the two historically observed?) conceptions of evolution are: development as decrease and increase as repetition; and development as a unity of opposites (the division of the one into mutually exclusive opposites and their reciprocal correlation). The first conception is dead, poor, and dry; the second is vital. It is only this second conception which offers the key to understanding the 'self-movement' of everything in existence; it alone offers the key to understanding 'leaps,' to the 'interruption of gradual succession,' to the 'transformation into the opposite,' to the destruction of the old and the appearance of the new." [M.E., p. 323 (manuscript notes)]

We shall have to see how far this rather ambitious claim can be verified in the field of science.

Above all, dialectical materialism insists on the reality of change. It claims to go back beyond Plato and Socrates to Heraclitus, and in particular it welcomed the new developments of physics which seemed to some to spell the end of materialism, and which undoubtedly were the end of the very narrow forms of materialism current in many scientific circles at the end of the nineteenth century, and still current in some of them.

As we saw above, Lenin wrote: [M.E., p. 220]

"The sole 'property' of matter--with the recognition of which materialism is vitally connected--is the property of being objective reality, of existing outside our cognition."

And for that reason, he was very far from upset by the revolutionary physical discoveries of his time.

Again, Engels [F., p. 51] said:

"The great basic thought that the world is not to be comprehended as a complex of ready-made things, but as a complex of processes, in which the things apparently stable no less than their mind-images in our heads, the concepts, go through an uninterrupted change of coming into being and passing away, in which, in spite of all seeming accidents and all temporary retrogression, a progressive development asserts itself in the end--this great fundamental thought has, especially since the time of Hegel, so thoroughly permeated ordinary consciousness that in this generality it is scarcely ever contradicted. But to acknowledge this fundamental thought in words and to apply it in reality in detail to each domain of investigation are two different things."

You will see that in the idea of process as fundamental, we have the anticipation of much of what is valuable in the philosophies of Bergson and Whitehead. Later on I hope to show how these principles work, or at least to examine whether they work, in the field of science.
I am perfectly aware that my approach has been extremely incomplete. If anyone wishes to study
the matter in detail, I would recommend them to read *Feuerbach* and *Anti-Duhring*, remembering
that they were written from the point of view of the science of sixty years ago, and that therefore
certain of the statements made in them would obviously have to be modified to meet recent
developments of science.

An important type of dialectical process is as follows. We study some thing or some process in
isolation. We produce a theory and we find that that theory is unsatisfactory because we have
ignored the background. Now afterwards it is very easy for any critic to say, "Well, your original
theory was just a piece of absurdity. Anyone could tell that it wasn't going to work!" Unfortunately,
in practice we find that until we had produced the theory which worked up to a point and then broke
down, we could not tell what elements we had ignored and should not have ignored. Let us take an
example from chemistry. In the Middle Ages, no self-respecting alchemist would have dreamed of
doing any chemical process which was in any way difficult without first observing the position of
the planets. For example, if it was an operation involving tin, he would presumably have seen that
the experiment was begun when Jupiter was in the ascendant, because Jupiter was the planet
presiding over tin. One of the greatest steps in chemical progress ever taken was when some bold
man actually began making experiments without first observing the planets, and found that they
were just as successful as before. Nevertheless, when chemical theory and practice progressed, it
was found that there were certain things in the background which could not be ignored, things of
which the medieval alchemists had never even dreamed. For example, it is clear that in any
chemical experiment involving the measurement of the amount of gas produced, it is necessary to
read not only the thermometer, but the barometer; and it is only when one takes account of the
variations in the barometric pressure that one gets anything like exactitude in such measurements.

Now this increasing importance of the background is often a part of the historical process. For
example, in what we believe to be the most primitive type of human life known to us, the collecting
stage, which comes even before the stage of hunting, it is clear that the most effective community
was the family. The same is still true of a society based on very simple hunting and fishing. In that
stage of human development, the only sensible philosophy was anarchism--let your neighbour
alone. Larger communities, however, are necessitated by denser populations due to more effective
production, and some form of organization above the family becomes necessary. You can no longer
neglect the background of other human families.

In the same way it is believed by many people that whereas a hundred years ago the national state
could be regarded to a very considerable extent in isolation, that is now no longer possible, owing to
the great development of transport, including the transport not only of men and merchandise, but
also of bombs.

There is a special case which arises when the situation is altered by our own knowledge of it.
Engels attributed to Hegel the statement: "Freedom is the recognition of necessity." I think that
actually the first man who made that statement was not Hegel, but Spinoza. It is a paradox, but in
many cases it is true. Let us take the following statement: "If you drink water polluted with *Bacillus
typhosus*, you will probably get typhoid fever." That statement is substantially true, until we
recognize that it is true, and take action based upon it. Until its truth was recognized, men tried all
sorts of methods of dealing with typhoid epidemics; magic, power, war on bad smells, and so on,
without very conspicuous success. Now the curious thing is that when that statement regarding
typhoid was not only put forward, but was made the basis of action, it ceased to be true. It
immediately became a lie, because you have to add to the words "you will probably get typhoid
fever," "but not if your water is boiled or chlorinated, or if you get yourself immunized." In other
words, by recognizing the necessity, you are able in that case and in many others to circumvent it.

The same thing is true of the doctrine of historical materialism. It may be claimed, in my opinion
with a very large measure of truth, that man is to a considerable extent a slave of economic
conditions, until he recognizes the fact; and the idealist, who denies the principle of historical
materialism completely, is as much in the grip of economic conditions as anyone else. Marxists believe that the principle of economic determinism of other human activities is largely true, but they are out to make it untrue by founding a society in which economic classes have been abolished, and in which this particular kind of determinism no longer holds.

Of course, no Marxist would claim that before Marx's time no one struggled against economic conditions. On the contrary, almost if not quite all the political struggles of the past were at bottom struggles against economic conditions. The struggle was often unconscious, but sometimes fully conscious. But the participants in these past struggles concentrated on their immediate problems, and did not see them in their full historical perspective. The fact that Marxism lays so much stress on this struggle of human beings against economic forces makes it clear that the doctrine of economic fatalism is no part of the Marxist philosophy. On the contrary, Marxism unifies the theory of the struggle against economic fatalism with its actual practice.

The above is a very characteristic type of dialectical process, on which Professor Levy has laid particular stress in a number of papers and a recent book. [*A Philosophy for a Modern Man*, Alfred A. Knopf, 1938]

Before we pass on, I want to compare this Hegelian-Marxist dialectic for one moment with that of Socrates, who may be said to have introduced the dialectical method into philosophy.

So far as we can make out, the Socratic method of operation was as follows: he started a conversation with some unfortunate Athenian citizen on a topic such as the nature of justice, and made his unlucky and unsuspecting interlocutor contradict himself. As a result of those contradictions, he arrived, if not at the truth, at any rate somewhat nearer the truth than his starting-point.

Plato wrote that the dialectical method was a means of arriving at absolute truth. For example, if the question discussed was, "What is Justice?" Plato thought that justice corresponded with some eternal idea, and that by examining the ordinary man's idea of justice, showing where it contradicted itself, and in consequence amending it so that it was no longer self-contradictory, he could arrive at a knowledge of that eternal idea of justice. We now, most of us, doubt whether Plato was correct; and there has been a tendency, especially perhaps among scientific people, to say that Socrates was merely investigating the meaning of words, and doing something pretty unimportant. I believe that this view is also incorrect. The word "justice" in Athens stood, if not for an eternal idea, at any rate for a social reality for which men were willing to die or to kill. But justice in Athens, even justice as conceived by the most enlightened Athenian, was by no means the same as justice in England today. Very few, if any, of Socrates' interlocutors would have regarded slavery as an essentially unjust institution; and in the same way, justice in twentieth-century England presumably means something different from what it will mean a hundred years hence.

We may conclude then, that while this verbal or argumentative dialectical process can take us a certain way, can clarify our ideas to a considerable extent, yet history applies a dialectical process of a far more searching character to our social institutions, bringing out contradictions which no amount of mere argument would have disclosed.

The Marxist theory of truth is, I think, straightforward and simple, but by no means complete. The view taken is that an indefinite progress is made in the direction of truth, except, perhaps, on fairly trivial matters such as the date of a given man's birth or death. This doctrine is, of course, familiar to English students of philosophy in a slightly different form in the work of Bradley. A short quotation from Engels [*A.D.*, p. 101] states the Marxist point of view clearly:

"The sovereignty of thought is realized in a series of extremely unsovereignly-thinking human beings; the knowledge which has an unconditional claim to truth is realized in a series of relative errors; neither the one nor the other can be fully realized except through an endless eternity of human existence."
"Here once again we find the same contradiction as we found above, between the character of human thought, necessarily conceived as absolute, and its reality in individual human beings with their extremely limited thought. This is a contradiction which can only be solved in the infinite progression, of what is for us, at least from a practical standpoint, the endless succession, of generations of mankind. In this sense human thought is just as much sovereign as not sovereign, and its capacity for knowledge just as much limited as unlimited. It is sovereign and unlimited in its disposition, its vocation, its possibilities and its historical purpose; it is not sovereign and it is limited in its individual expression and in its realization at each particular moment.

"It's just the same with eternal truths. If mankind ever reached the stage at which it could only work with eternal truths, with conclusions which possess sovereign validity and have an unconditional claim to truth, it would then have reached the point where the infinity of the intellectual world both in its actuality and in its potentiality had been exhausted, and this would mean that the famous miracle of the infinite series which has been counted would have been performed."

On the whole we may take it that Marxists are rather sceptical of the more ambitious logical theories. For example, the system of Russell and Whitehead, in the *Principia Mathematica* is doubtless true, or largely true, if sufficiently sharp classification is possible.

It is, of course, based on the hypothesis that existents (e.g. dogs, lightning flashes, and sensations), relations (e.g. greater than, father of, desired by), and propositions (e.g. this hat is black, all pigs have heads, I want a drink), can be arranged in classes. Then, for example, if a one to one correspondence can be made between the members of two classes, say the bright stars in the Plough and the petals of a typical Purple Loosestrife flower, these two classes are members of a class which also includes the class of days in the week and the class of dwarfs who befriended Snow White. This super-class is the number seven. And on this basis the fundamental theorems of mathematics can be proved.

If then we can divide up all animals precisely into different species, between which the distinctions are at all times well marked, no doubt the Russell-Whitehead theory of classification will hold. But actually this division of animals into species or other higher categories is by no means universally valid. The gap between species is bridged not only by evolution in the past, but in some cases at any rate, by hybridization in the present. Engels made very great play with animals which bridged gaps—*Archaeopteryx*, which bridged the gap between reptiles and birds, and *Ceratodus*, bridging to some extent the gap between the fish and the amphibia, though, of course, far less completely than many fossil forms since discovered. For that reason it is probable that too great emphasis has been attached to logical systems which will only work for material that has certain highly abstract properties, which are rather less frequently and much less completely exemplified in the real world than logicians would like to think.

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*Haldane Archive*
MARXISM has a two-fold bearing on science. In the first place Marxists study science among other human activities. They show how the scientific activities of any society depend on its changing needs, and so in the long run on its productive methods, and how science changes the productive methods, and therefore the whole society. This analysis is needed for any scientific approach to history, and even non-Marxists are now accepting parts of it. But secondly Marx and Engels were not content to analyse the changes in society. In dialectics they saw the science of the general laws of change, not only in society and in human thought, but in the external world which is mirrored by human thought. That is to say it can be applied to problems of "pure" science as well as to the social relations of science.

Scientists are becoming familiar with the application of Marxist ideas to the place of science in society. Some accept it in whole or in part, others fight against it vigorously, and say that they are pursuing pure knowledge for its own sake. But many of them are unaware that Marxism has any bearing on scientific problems considered out of their relation to society, for example to the
problems of tautomerism in chemistry or individuality in biology. And certain Marxists are inclined to regard the study of such scientific and philosophical problems as unimportant. Yet they have before them the example of Lenin. In 1905 the Russian Revolution had failed. It was necessary to build up the revolutionary movement afresh. Lenin saw that this could only be done on a sound theoretical basis. So he wrote Materialism and Empirio-criticism. This involved a study, not only of philosophers such as Mach and Pearson, whom he criticised, but of physicists such as Hertz, J. J. Thomson, and Becquerel, whose discoveries could be interpreted from a materialistic or an idealistic point of view. However, Lenin did not attempt to cover the whole of science. He was mainly concerned with the revolution in physics which was then in progress, and had little to say on astronomy, geology, chemistry, or biology.

But thirty years before Lenin, Engels had tried to discuss the whole of science from a Marxist standpoint. He had always been a student of science. Since 1861 he had been in close touch with the chemist Schorlemmer at Manchester, and had discussed scientific problems with him and Marx for many years. In 1871 he came to London, and started reading scientific books and journals on a large scale. He intended to write a great book to show "that in nature the same dialectical laws of movement are carried out in the confusion of its countless changes, as also govern the apparent contingency of events in history." If this book had been written, it would have been of immense importance for the development of science.

But apart from political work, other intellectual tasks lay before Engels. Dühring had to be answered, and perhaps Anti-Dühring, which covers the whole field of human knowledge, is a greater book than Dialectics of Nature would have been had Engels completed it. After Marx's death in 1883 he had the gigantic task of editing and completing Capital, besides which he wrote Feuerbach and The Origin of the Family. So Dialectics of Nature was never finished. The manuscript consists of four bundles, all in Engels' handwriting, save for a number of quotations from Greek philosophers in that of Marx. Part of the manuscript is ready for publication, though, as we shall see, it would almost certainly have been revised. Much of it merely consists of rough notes, which Engels hoped to work up later. They are often hard to read, and full of abbreviations, e.g. Mag. for magnet and magnetism. There are occasional scribbles and sketches in the margin. Finally, although the bulk of the manuscript is in German, Engels thought equally well in English and French, and occasionally produced a hybrid sentence, such as "Wenn Coulomb von particles of electricity spricht, which repel each other inversely as the square of the distance, so nimmt Thomson das ruhig hin als bewiesen." Or "In der heutigen Gesellschaft, dans le méchanisme civilisé, herrscht duplicité d'action, contrariété de l'intérêt individuel avec le collectif; es ist eine queue universelle des individus contre les masses." The translation has been a very difficult task, and the order of the different parts is somewhat uncertain.

Most of the manuscript seems to have been written between 1872 and 1882, that is to say it refers to the science of sixty years ago. Hence it is often hard to follow if one does not know the history of the scientific practice and theory of that time. The idea of what is now called the conservation of energy was beginning to permeate physics, chemistry, and biology. But it was still very incompletely realised, and still more incompletely applied. Words such as "force," "motion," and "vis viva" were used where we should now speak of energy. The essays on "Basic forms of motion," "The measure of motion - work," and "Heat" are largely concerned with the controversies which arose from incomplete or faulty theories about energy. They are interesting as showing how ideas on this subject developed, and how Engels tackled the controversies of his day. However many of these controversies are now settled. The expression vis viva is no longer used for double the kinetic energy, and "force" has acquired a definite meaning in physics. Engels would not have published them in their present form, if only because, in the later essay on tidal friction, he uses a more modern terminology. Their interest lies not so much in their detailed criticism of theories, many of which have ceased to be of importance, but in showing how Engels grappled with intellectual problems. The essay on electricity "dates" even more. As a criticism of Wiedemann's inconsistencies it is interesting, and it ends with a plea for a closer investigation of the connection.
between chemical and electrical action, which, as Engels said, "will lead to important results in both spheres of investigation." This prophecy has, of course, been amply fulfilled. Arrhenius' ionic theory has transformed chemistry, and Thomson's electron theory has revolutionised physics. Here again, the manuscript would certainly have been revised before publication. In a letter to Marx on November 23rd, 1882, he points out that Siemens, in his presidential address to the British Association, has defined a new unit, that of electric power, the Watt, which is proportional to the resistance multiplied by the square of the current whereas the electromotive force is proportional to the resistance multiplied by the current. He compares these with the expressions for momentum and energy, discussed in the essay on "The measure of motion - work," and points out that in each case we have simple proportionality (momentum as velocity and electromotive force as current) when we are not dealing with transformation of one form of energy into another. But when the energy is transformed into heat or work the correct value is found by squaring the velocity or current. "So it is a general law of motion which I was the first to formulate." We can now see why this is so. The momentum and the electromotive force, having directions, are reversed when the speed and current are reversed. But the energy remains unaltered. So the speed or the current must come into the formula as the square (or some even power) since \((-x)^2 = x^2\).

In the essay on "Tidal friction," Engels made a serious mistake, or more accurately a mistake which would have been serious had he published it. But I very much doubt whether he would have done so. In the manuscript notes for Anti-Dühring,[1] he supported the view, quite commonly held in the nineteenth century, that we find truths such as mathematical axioms self-evident because our ancestors have been convinced of their validity, while they would not appear self-evident to a Bushman or Australian black. Now this view is almost certainly incorrect, and Engels presumably saw the fallacy, and did not have it printed. I have little doubt that either he or one of his scientific friends such as Schorlemmer would have detected the mistake in the essay on "Tidal friction." But even as a mistake it is interesting, because it is one of the mistakes which lead to a correct result (namely that the day would shorten even if there were no oceans) by incorrect reasoning. Such mistakes have been extremely fruitful in the history of science.

Elsewhere there are statements which are certainly untrue, for example in the sections on stars and Protozoa. But here Engels cannot be blamed for following some of the best astronomers and zoologists of his day. The technical improvement of the telescope and microscope has of course led to great increases in our knowledge here in the last sixty years.

On the other hand, Engels' remarks on the differential calculus, though inapplicable to that branch of mathematics as now taught, were correct in his own day, and for some time after. He points out that it actually developed by contradiction, and is none the worse for that. To-day "rigorous" proofs are given of many of the theorems to which he refers, and some mathematicians claim to have eliminated the contradictions. Actually they have only pushed the contradictions into the background, where they remain in the field of mathematical logic. Not only has every effort to deduce all mathematics from a set of axioms, and rules for applying them, failed, but Gödel has proved that they must fail. So the fact that the calculus can be taught without involving the particular contradictions mentioned by Engels in no way impugns the validity of his dialectical argument.

When all such criticisms have been made, it is astonishing how Engels anticipated the progress of science in the sixty years which have elapsed since he wrote. He certainly did not like the atomic theory of electricity, which held sway from 1900 to 1930, and until it turned out that the electron behaved not only like a particle but like a system of moving waves he might well have been thought to have "backed the wrong horse." His insistence that life is the characteristic mode of behaviour of proteins appeared to be very one-sided to most biochemists since every cell contains many other complicated organ substances besides proteins. Only in the last four years has it turned out that certain pure proteins do exhibit one of the most essential features of living things, reproducing themselves in a variety of environments.
While we can everywhere study Engels' method of thinking with advantage, I believe that the sections of the book which deal with biology are the most immediately valuable to scientists to-day. This may of course be because as a biologist I can detect subtleties of Engels' thought which I have missed in the physical sections. It may be because biology has undergone less spectacular changes than physics in the last two generations.

In order to help readers to follow the development of science since Engels' time, I have added some notes. A few readers may object to my pointing out that Engels was occasionally wrong. Engels would not have objected. He was well aware that he was not infallible, and that the Labour Movement wants no popes or inspired scriptures. *The Condition of the Working Class in England in 1844*, of which an English translation had been published in America in 1885, was first published in England in 1892. In his preface written after forty-eight years he says:

"I have taken great care not to strike out of the text the many prophecies, amongst others that of an imminent social revolution in England, which my youthful ardour induced me to venture upon. The wonder is, not that a good many of them proved wrong, but that so many of them have proved right."

I think that readers of *Dialectics of Nature* will come to a similar conclusion.

I have not yet mentioned the sections on the history of science. These are among the most brilliant passages in the whole book, but they represent a line of thought which was followed by Marx and Engels in many of their books and which has since been developed by others, so most readers will find them less novel. Finally, there is the delightful essay on "Scientific research into the spirit world." There is a tendency among materialists to neglect the problems here dealt with. It is worthwhile noticing that Engels did not do so. On the contrary he produced a number of phenomena which were regarded as "occult" and mysterious in his day, and arrived at the same conclusions as most scientific investigators in this field have reached, provided that, like Engels, they brought to their work robust common sense, and also a sense of humour.

It was a great misfortune, not only for Marxism, but for all branches of natural science, that Bernstein, into whose hands the manuscript came when Engels died in 1895, did not publish it. In 1924 he submitted it (or part of it) to Einstein, who, though he did not think it of great interest from the standpoint of modern physics, was on the whole in favour of publication. If, as seems likely, Einstein only saw the essay on electricity, his hesitation can easily be understood, since this deals almost wholly with questions which now seem remote. The manuscript was first edited by Riazanov, and printed in 1927. However, Adoratski's edition of 1935 is more satisfactory, as several passages which made nonsense in the earlier edition have now been deciphered.

Had Engels' method of thinking been more familiar, the transformations of our ideas on physics which have occurred during the last thirty years would have been smoother. Had his remarks on Darwinism been generally known, I for one would have been saved a certain amount of muddled thinking. I therefore welcome wholeheartedly the publication of an English translation of *Dialectics of Nature*, and hope that future generations of scientists will find that it helps them to elasticity of thought.

But it must not be thought that *Dialectics of Nature* is only of interest to scientists. Any educated person, and, above all, anyone who is a student of philosophy, will find much to interest him or her throughout the book, though particularly in Chapters I, II, VII, IX, and X. One reason why Engels was such a great writer is that he was probably the most widely educated man of his day. Not only had he a profound knowledge of economics and history, but he knew enough to discuss the meaning of an obscure Latin phrase concerning Roman marriage law, or the processes taking place when a piece of impure zinc was dipped into sulphuric acid. And he contrived to accumulate this immense knowledge, not by leading a life of cloistered learning, but while playing an active part in politics, running a business, and even fox-hunting!

He needed this knowledge because dialectical materialism, the philosophy which, along with Marx,
he founded, is not merely a philosophy of history, but a philosophy which illuminates all events whatever, from the falling of a stone to a poet's imaginings. And it lays particular emphasis on the inter-connection of all processes, and the artificial character of the distinctions which men have drawn, not merely between vertebrates and invertebrates or liquids and gases, but between the different fields of human knowledge such as economics, history, and natural science.

Chapter II contains an outline of this philosophy in its relation to natural science. A very careful and condensed summary of it is given in Chapter IV of the History of the C.P.S.U.(B), but the main sources for its study are Engels' Feuerbach and Anti-Dühring, Lenin's Materialism and Empirio-criticism, and a number of passages in the works of Marx. Just because it is a living philosophy with innumerable concrete applications its full power and importance can only be gradually understood, when we see it applied to history, science, or whatever field of study interests us most. For this reason a reader whose concern lies primarily in the political or economic field will come back to his main interest a better dialectical materialist, and therefore a clearer-sighted politician or economist, after studying how Engels applied Dialectics to Nature.

At the present moment, clear thinking is vitally necessary if we are to understand the extremely complicated situation in which the whole human race, and our own nation in particular, is placed, and to see the way out of it to a better world. A study of Engels will warn us against some of the facile solutions which are put forward to-day, and help us to play an intelligent and courageous part in the great events of our own time.

J. B. S. HALDANE.

November, 1939.

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Notes

1. See p. 314.

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JBS Haldane

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PREFACE

THIS BOOK IS BASED UPON THE MUIRHEAD lectures on political philosophy delivered in the University of Birmingham in January and February 1938. I have expanded them to deal more fully with matters of detail. They are primarily addressed to scientific workers and students, in the belief that Marxism will prove valuable to them in their scientific work, as it has to me in my own. But in view of the general importance of the subject I hope to interest a somewhat wider audience.
I have tried to apply Marxism to the scientific problems of my own day, as Engels did over many years, and Lenin in 1908. I do not doubt that I have made mistakes. A Marxist must not be too afraid of making mistakes.

Such an attempt as mine inevitably invites one of two criticisms. If one confines oneself to well-established scientific facts, one is told that it is easy to apply Marxism after the event, and that with sufficient ingenuity one can find a quotation from Marx or Engels which is apposite to any piece of recent scientific work. If, on the other hand, one ventures into speculation one is certain to be wrong on points of detail, if not on more fundamental matters. Nevertheless, I think it is worthwhile to demonstrate the kind of speculations into which Marxism leads a scientist.

For an acceptance of this philosophy inevitably induces novel types of action and thought. This must be my apology for parts of Chapter 5 which some readers will consider an excrescence on an otherwise useful book.

I have tried to cover a very wide field, and am fully aware that I have done so both unevenly and superficially. I hope, however, that I may stimulate others to fill in the gaps in my exposition and to correct it where necessary. An adequate Marxist interpretation of science can only arise in an atmosphere of vigorous controversy, and I wish to make it absolutely clear that I expect to be criticized. But I hope that the criticism to which I am subjected from Marxist writers will be constructive.

I have used the following abbreviations in my citations:

- C. Capital, Karl Marx. English translation by Moore and Aveling. (Modern Library, New York.)
- O. F. The Origin of the Family, Private Property, and the State, Frederick Engels, 1884. English translation by Ernest Untermann. (Kerr, Chicago.)

I hope that many of my readers will be induced to study these books.

SOME MARXIST PRINCIPLES

I OWE TWO APOLOGIES TO MY AUDIENCE AND readers. In the first place I am not primarily a philosopher; but when I am asked to lecture on political philosophy, I can choose no more appropriate subject than the most political of all philosophies, that of Marx. The second apology is more serious. I am by no means qualified to speak on Marxism. I have only been a Marxist for about a year. I have not yet read all the relevant literature, although I had of course read much of it before I became a Marxist. The object of these lectures will not only be to enlighten my audience, but to clarify my own thoughts. It will be remembered that Socrates described himself as the midwife who helped the unborn thoughts of others into the world. I will ask my hearers and readers to function in that capacity in my own case.

Now we must ask ourselves at once, why is Marxism important? I think I may presume that the majority of my audience and a considerable fraction of my readers are hostile to it. Why should they worry about it? One reason is because it is a philosophy of very great practical importance, a philosophy which is not less important if one decides that it is entirely false. It makes a considerable difference to the conduct of its adherents. I believe that one could spend a week (in vacation time, at any rate) with the average academic philosopher without discovering whether he was an idealist or
a realist, but I do not think that one could spend a day with a Marxist without discovering his tenets. There are two other important philosophies which issue in action to a very considerable extent. The first is the scholastic philosophy, whose greatest exponent was St. Thomas Aquinas. That philosophy represents not merely the opinions of a few people, or even of the whole body of priests and monks, but the practice of the great medieval civilization. That philosophy is still active in guiding the activity of the Roman Catholic Church. It is, therefore, deserving of study whether we adhere or object to it, simply because the Catholic Church is a very important institution. The second of these practically important philosophies is what a century or two ago was called natural philosophy, and is now called science. It is, however, limited in its scope. It has certainly been successful in some fields. In others it has had less application. It has undoubtedly transformed the world.

Now Marxism claims to apply scientific method in the field of politics and economics, and to predict and to enable us to control the transformation of the world still further. Because it extends scientific method into the human field it throws a new light on science, as a human activity depending both on contemporary social and economic conditions and also on certain very general laws of human thought. It further lays down some principles which are said to hold throughout nature, as well as applying to human activities. We shall have to investigate these claims in what follows.

Above all, I believe that I am justified in giving these lectures because of the very remarkable misapprehensions which undoubtedly exist in many quarters regarding the Marxist philosophy. A good many people do not, I think, even know of its existence. They know nothing of the theoretical side of Marx's work, except, perhaps, the doctrine of surplus value. If they hear that Marxism is materialism, they think materialism is the theory that man is a machine, or the denial of the existence of mind.

Now, until 1917, it might have been possible to dismiss Marxism as the doctrine of a small set of cranks, no more important than the doctrines of Bakunin, Sorel, or other revolutionary theorists. This was particularly so in England, where Marxism was largely ignored both in academic and political circles, whereas on the continent of Europe it was at least considered worthy of criticism. You will remember, however, one of the definitions of a crank, covering both the human and mechanical kinds, as "A little thing that makes revolutions"! It is now impossible to doubt the importance of Marxism, because Marxism was the philosophy of Lenin. It is very difficult to deny that Lenin was the greatest man of his time. Not that this admission need imply agreement with him. It is perfectly possible, without being a Mohammedan, to admit that Mohammed was the greatest man of his time. The philosophy of a man who has had so great and important an influence on world history as Lenin is undoubtedly worthy of investigation.

You will remember that Plato said that the ideal state was only possible when a philosopher became a king. Lenin was, amongst other things, a philosopher. We shall have to examine some of his philosophical views later on. He became, if not a king or even a dictator, the most important man, and the ideological leader, of a community covering most of the former Russian Empire. And that community is still largely guided by the principles which he laid down. The Soviet Union is certainly not the ideal state, for one reason because Marxists are not interested in ideal states, but in actual or possible states. Lenin's philosophy is today very much alive, both in the Soviet Union, and among communists and other Marxists who are not members of the communist party, outside the Soviet Union. The intensity of the interest taken in philosophy in the Soviet Union may be gauged by the statement, which I believe to be true, that in 1936, one hundred thousand copies of a translation of certain of Kant's works (I cannot believe they were his complete works!) were printed, and the whole lot sold out. Philosophy is at any rate a subject of very general interest in the U.S.S.R., and one result of communist propaganda in Britain has been a revival of interest in philosophy.

Such are some of the reasons why even those who are convinced of the truth of some other
philosophy, and of the rightness of some other political practice, should be willing to make at least a superficial study of Marxism. My own reason for delivering these lectures is a different one. I think that Marxism is true.

Now, what is Marxism? Plekhanov, a Russian Marxist and predecessor of Lenin, began his book, *Fundamental Problems of Marxism*, with the statement: "Marxism is a complete theoretical system." That is approximately true of the philosophy of Aristotle, St. Thomas, Spinoza, or Hegel. Clearly it is not true of the philosophy of Socrates. It is also untrue of Marxism. Marxism is not complete, not a system, and only in the second place theoretical. It is not complete because it is alive and growing, and above all because it lays no claim to finality. The most that a Marxist can say for Marxism is that it is the best and truest philosophy that could have been produced under the social conditions of the mid-nineteenth century. It is not primarily a system, but a method. As Marx said in the Eleventh Thesis on Feuerbach: [F., p. 75] "The philosophers have only interpreted the world in various ways: the point is to change it." Like Descartes, he regarded his philosophy as primarily a method, and although theory is essential in Marxism, Marx proclaimed the primacy of practice over theory.

This is not, of course, to say that Marxism does not include a great deal of systematic theory, which is to a large extent the fruit of the method. But the details of Marxist theory, like those of the theories of natural science, are the result of applying the method to concrete situations. And the theory which exists was built up with far more attention to observed facts and far less "pure thought" than the great philosophies of the past.

A few words are necessary about the historical origins and sources of Marxism. Marx was born in 1818 at Trier, in south-western Germany; his father was a Jewish lawyer who came to Protestantism when Karl was six years old. His colleague, Friedrich Engels, to whom Marxism owes so much, was born in 1820 at Barmen, in Rhineland. His father was a German manufacturer. Both studied philosophy. Marx got his Doctorate for a thesis on the philosophy of Epicurus; they both became left-wing Hegelians, and later followers of Feuerbach. Marx wanted to become a philosopher, and it is likely that had he become a professor he would have been a good deal more innocuous to the social system in which he lived than actually proved to be the case. However, the Prussian Government dismissed a number of people like Feuerbach and Bauer, whose philosophical and political views, though radical, were very much milder than Marx's views later became. Marx took to journalism. He was one of the founders of the radical *Rheinische Zeitung* in 1842. When it was suppressed in 1843, he went to Paris. Meanwhile, Engels had gone to Manchester in 1842, where he worked as a cotton broker and studied the life of the working people. His book, *The Condition of the Working Class in England*, was published in 1845.

In 1844, Marx and Engels met in Paris, and became lifelong friends. They came under the influence of French revolutionary theorists like Proudhon, and became Socialists. In 1845, at the instance of the Prussian Government, Marx was forced to leave Paris, and went to Brussels. By this time their views had been considerably clarified. They were in disagreement with Proudhon and other French leaders, and their economic and political outlooks were stated in the "Communist Manifesto," which Engels drafted, and which was published in 1847.

In 1848, both took part in the revolution in Germany, Marx as a journalist, Engels as a soldier. From 1849 onward, they lived most of their lives in England until Marx died in 1883 and Engels in 1895. Marx lived in London, Engels in Manchester until 1871, when he, too, came to London.

Apart from their political work such as that involved in founding the International Working Men's Association, later known as the First International, they wrote on a very large scale during those years. Marx's most important book was, of course, *Das Kapital*, but in discussing the relation of Marxism to science we shall mainly be concerned with the views expressed by Engels. His most important books for our purpose are, *Herr Eugen Duhring's Revolution in Science*, written in 1878, and popularly known as *Anti-Duhring*, and a smaller book called *Ludwig Feuerbach and the Outcome of Classical German Philosophy*, written in 1888. Finally, we have a large number of
manuscript notes of Engels, which although never published in book form, have appeared in the Marx-Engels Archiv, under the title, "Dialektik and Natur." *Anti-Duhring* and *Feuerbach* are both polemical works, and most people find them easy to read. But they are somewhat of a puzzle for an ordinary philosophical student, for a number of reasons. It is important to remember that Duhring, whose writings Engels analyzed with considerable sarcasm, was a Socialist and a materialist, with whom he had enough in common to furnish a real basis of argument. He attacked him with considerable vehemence on the points on which they differed.

Again, Engels professed himself a disciple of Feuerbach, but was critical of his opinions in a number of respects. Similarly, his joint work with Marx, *The Holy Family*, was directed against Bruno Bauer, with whom they were in a considerable measure of agreement, and the *Poverty of Philosophy* was directed against Proudhon. It is a characteristic of all these books that they are written, not against open enemies, but against persons with whom the authors had a good deal in common. This makes them difficult reading for one who is accustomed to the average philosophical work, which is addressed to the whole world, so to speak, and not to a group with which the author has only a limited number of bones to pick.

Why, it may be asked, should Engels not have attacked such contemporaries as Comte, Mill, Spencer, or Green, from whom he differed on almost all points? Perhaps the answer is as follows. It was obvious that such philosophies as these would become obsolete in a relatively short time. Many of the political and economic theories of Mill and Spencer are simply irrelevant to modern conditions. On the other hand, the views of Duhring and Feuerbach are held by a good many modern Socialists. Engels attacked "right" theories, not in their crude form, but in their most dangerous form. In fact, he chose not the easiest, but the most difficult antagonists.

Lenin's only important philosophical work is called *Materialism and Empirio-Criticism*. It was published in 1908 and was directed mainly against Bogdanov, Lunacharsky, and others who claimed to be Marxists. Lunacharsky later became one of Lenin's colleagues in the Government of the U.S.S.R. At first reading, Lenin's book might seem to be an attempt to impose a formal, narrow Marxist orthodoxy. Actually he is undoubtedly justified, when Bogdanov claims to be a Marxist, in quoting passages from Marx which disagree with Bogdanov. The whole book is a book characteristic of a fighter. His attacks are mainly directed against compromisers, whether within the Marxist movement, like Bogdanov and Lunacharsky, or outside it, like Mach and Avenarius. His opinion was that "non-partisans in philosophy are just as muddle-headed as in politics." On the other hand he recognized and admired clear thinking wherever he found it, and in consequence was often extremely polite to his out and out opponents, like James Ward, to whom he refers in the following sentence, among others: "The question, as put by this frank and consistent spiritualist is remarkably clear and to the point." Similarly, Karl Pearson is described as "this conscientious and honest enemy of materialism." Besides this, some short but most important manuscript notes by Lenin on philosophical problems have been published.

In these lectures, we shall mainly be concerned with the relationship of Marxism to science, as developed by Engels in *Feuerbach* and *Anti-Duhring*, and by Lenin. Lenin's welcome to the new developments in physics, such as radioactivity and electrons, is particularly interesting as showing the relation of Marxism to discoveries which have been supposed to disprove its basic principles. However, Engels is the chief source, although he states expressly that most of the leading principles in his work derived from Marx.

Now a student of academic philosophy who takes up a study of Marxism will at first be disappointed. A great many questions are left unanswered, for two different reasons. Some were shown to be improperly put, and it was sufficient to demonstrate the historical reasons why they had been asked in the past. Others could not be answered on the existing data. Thus the relation between brain and mind is not in principle an insoluble problem; but it cannot be solved, except in the most summary manner, until we know a very great deal more, particularly about the brain. Marxism is not concerned mainly with being, but with becoming. It claims to enable us to understand change
and development of all kinds, not only political and economic change and development, and by understanding to influence and to control them.

Most philosophers have treated time and change as more or less illusory, though since Hegel's day they are more often taken seriously. An attempt is made to find a timeless being behind this changeable world. That is conspicuously so in the philosophy of Plato. It is worth pointing out that Christianity differs from most of the academic philosophies in ascribing a supreme importance to a number of events in time--the Creation, the Fall, the Redemption of Mankind, and the Last Judgment. That was particularly so in primitive Christianity; and as it ceased to be a revolutionary religion, certain theologians tried to make its theory more and more static. In the first centuries of Christianity, theology was considerably influenced by the neo-Platonists, and in our own day we find such philosophers as Dean Inge trying to minimize the temporal side of theology and to exalt the timeless side. It is not, of course, a mere coincidence that their political views are usually reactionary.

While Marxism makes what at the very least must be admitted to be an ambitious attempt to solve the problems of becoming, it has very little to say concerning the problems of being raised in the classical philosophies. It dismisses many of them as illusory problems which have arisen through unclear thinking. It postulates nothing behind matter, and therefore dismisses metaphysics. It certainly postulates an inexhaustible supply of properties of matter, but no more than that.

In the remainder of this chapter, I shall try to summarize some of the principles of Marxism, though mainly outside the economic field. I shall only deal in the most summary way with Marx's economic and political theories in the last chapter; and as I am not an economist, I do not pretend that my treatment will be either novel or authoritative. In the first place, we have the principle of the unity of theory and practice, with the primacy of practice. Let me quote one of Marx's theses on Feuerbach:

"The question whether objective truth can be attributed to human thinking is not a question of theory but is a practical question. In practice man must prove the truth, i.e. the reality and power, the 'this-sidedness' of his thinking. The dispute over the reality or nonreality of thinking which is isolated from practice is a purely scholastic question."

Again, Engels, in writing of astronomy, pointed out that in its early days, the Copernican hypothesis was only one of a number of theories, each of which would explain the facts with sufficient accuracy. It was only when, on the basis of Newton's theory of gravitation it was possible to predict such events as the finding of the planet Neptune and the return of Halley's Comet, that it could be taken as proved. All this is a commonplace for modern scientific theory, but it was by no means commonplace ninety years ago.

So far we may say that Marxism anticipates pragmatism, although it differs from pragmatism in almost all other respects, notably in its consistent emphasis on the changing of the world, and above all in its belief that there is a real world, and that absolute truth, if never reached, can be continually approached.

A second Marxist principle is materialism. This word has been used in a very large number of senses, and it is important to realize just what Marx meant by the term. Engels wrote [F., p. 31] as follows:

"The question of the relation of thinking to being, the relation of spirit to nature--the paramount question of the whole of philosophy--has, no less than all religion, its roots in the narrow-minded and ignorant notions of savagery. But this question could for the first time be put forward in its whole acuteness, could achieve its full significance, only after European society had awakened from the long hibernation of the Christian Middle Ages. The question of the position of thinking in relation to being, a question which, by the way, had played a great part also in the scholasticism of the Middle Ages, the question: which is primary, spirit or nature--that question, in relation to the Church, was sharpened into this: 'Did God create the world or has the world been in existence
eternally?"

"The answers which the philosophers gave to this question split them into two great camps. Those who asserted the primacy of spirit to nature and, therefore, in the last instance, assumed world creation in some form or another--(and among the philosophers, Hegel, for example, this creation often becomes still more intricate and impossible than in Christianity)--comprised the camp of idealism. The others, who regarded nature as primary, belong to the various schools of materialism.

"These two expressions, idealism and materialism, primarily signify nothing more than this; and here also they are not used in any other sense."

You will notice the emphasis which is laid on temporal priority rather than on logical priority. This is characteristic of a philosophical system which takes historical fact extremely seriously.

Now that definition of materialism is not accepted by many people. For example, my late father, J. S. Haldane, [Materialism, p. 5. (London, 1932) wrote as follows:

"Materialism may be defined as the belief that physico-chemical realism, or the assumption that the representation of our surrounding universe by the physical sciences in their traditional form corresponds to reality, can be extended so as to cover, not only the phenomena of life, but also those of conscious behaviour."

If we compare this with what Lenin wrote, we shall see that J. S. Haldane's view, so far at least as it is expressed in that passage, is not in conflict with Marxism. Lenin's words are:

"It is, of course, totally absurd that materialism should maintain the 'lesser' reality of consciousness or should necessarily adhere to a 'mechanistic world-picture' of matter in motion and not an electromagnetic, or even some immeasurably more complicated one." [M.E., p. 238]

Again, in another place, Lenin wrote:

"For the sole 'property' of matter--with the recognition of which materialism is vitally concerned--is the property of being objective reality, of existing outside of our cognition. ... The recognition of immutable elements, 'of the immutable substance of things,' is not materialism, but is metaphysical, anti-dialectical materialism." [M.E., p. 220]

It is clear, therefore, that what Marxism calls materialism is something a good deal less mechanical than the materialism of the French eighteenth-century philosophers. It is worth noting that although my late father was a strong opponent of materialism, his book, The Sciences and Philosophy, was recommended by a Moscow radio commentator as a very good introduction to dialectical materialism, although far from being Marxist.

Again, Lenin's attitude to idealism, although hostile, was not completely negative:

"Philosophical idealism is nonsense only from the standpoint of a crude, simple, and metaphysical materialism. On the contrary, from the standpoint of dialectical materialism philosophical idealism is a one-sided, exaggerated, swollen development (Dietzgen) of one of the characteristic aspects or limits of knowledge into a deified absolute, into something dissevered from matter, from nature." [M.E., p. 327 (manuscript notes)]

Why, then, many people ask, should you not drop this word "materialism" which has come to signify addiction to large dinners and expensive motor cars, and call it "realism" or something less challenging? The answer is that Marxism insists on the priority of matter, and that it is a fighting philosophy. Marxists must on occasion deal very vigorously with idealists. Today, for example, it is necessary to combat the propaganda of those pacifists who believe the world can be saved from war by goodwill acting, as it were, in a vacuum, and with the anarchists, who think that it is sufficient to destroy the existing State organizations, and human nature is good enough to do the rest.

The materialism of Marxists is called dialectical materialism, for a reason which will be explained later. Dialectical materialism as applied to human history is called historical materialism. This is the
aspect of Marxist philosophy which is probably most familiar to British readers. But it is only one aspect, and is not that with which we shall be mainly concerned in this book. The nature of the materialistic interpretation of history will be made clear by two quotations from Engels:

"The new facts made imperative a new examination of all past history, and then it was seen that all past history was the history of class struggles, that these warring classes of society are always the product of modes of production and exchange, in a word, of the economic conditions of their time; that therefore the economic structure of society always forms the real basis from which, in the last analysis, is to be explained the whole superstructure of legal and political institutions, as well as of the religious, philosophical, and other conceptions of each historical period. Now idealism was driven from its last refuge, the philosophy of history; now a materialistic conception of history was propounded, and the way found to explain man's consciousness by his being, instead of, as heretofore, his being by his consciousness." [A.D., p. 32]

Again, in another passage he says: [F., p. 62]

"In modern history at least it is therefore proved that all political struggles are class struggles, and all class struggles for emancipation in the last resort, despite their necessarily political form (for every class struggle is a political struggle), turn ultimately on the question of economic emancipation. Therefore, here at least, the state, the political order, is the subordinate, and civil society--the realm of economic relations--the decisive element. The traditional conception, to which Hegel, too, pays homage, saw in the State the determining element, and in civil society the element determined by it. Appearances correspond to this. As all the driving forces of the actions of any individual person must pass through his brain, and transform themselves into motives of his will in order to set him into action, so also all the needs of civil society--no matter which class happens to be the ruling one--must pass through the will of the State in order to secure general validity in the form of laws. That is the formal aspect of the matter--the one which is self-evident. The question arises, however, what is the content of this merely formal will of the individual as well as of the State--and whence is this content derived? Why is just this intended and not something else? If we enquire into this we discover that in modern history the will of the State is, on the whole, determined by the changing needs of civil society, by the supremacy of this or that class, in the last resort, by the development of the productive forces and relations of exchange."

The detailed economic theories of Marxism lie outside the scope of this book, as does the description of Marxist practice in the present class struggle.

Dialectical materialism is founded on Hegelian dialectic. It had long been realized that matter on the whole behaves intelligibly, conforming to the laws of logic and arithmetic. The question arose whether our reason mirrors the behaviour of matter, or whether on the other hand, matter mirrors the behaviour of mind. Kant's view was somewhere intermediate, perhaps leaning to the idealist side.

Hegel laid down, especially in his *Logic and Phenomenology of Mind*, a number of principles of thought going beyond those laid down by Aristotle and taught as formal logic, principles which had been more or less recognized for centuries, but never so clearly formulated. These principles were called dialectical principles. He said that nature conformed to them. According to Hegel the logical categories exist eternally; the world is a mere exemplification of these logical categories in space and time. Feuerbach, Marx, and Engels believed that the principles were exemplified in nature before they governed thought. According to Marx, the ideal is nothing but the material world reflected by the human mind, and translated into forms of "thought. Hegel is standing on his head. Our business is to put him on his feet. Engels treated the Hegelian dialectic as expressing primarily the properties of matter, and only secondarily the laws of thought. He held that the principles which Hegel had worked out in the realm of thought also applied to material events, not only in the social field, but in the fields of astronomy, physics, biology, and so on.

In what follows I propose to give a sketch of the dialectic so brief and abstract as to be almost a
caricature. I shall pass over many of its essential features, and attempt to summarize a few of its main principles. Such a presentation lays itself open to a severe criticism. The dialectic, which is a unity, appears as a collection of rules of thumb, one or other of which should be applied wherever possible. Such a point of view would, I am sure, be dispelled by a reading of Marx, Engels, and Lenin, or of a more modern exposition such as Jackson's Dialectics. I hope, indeed that the following chapters may serve to dispel it. If not, the fault is my own, not that of Marx, Engels, and Lenin.

What are these dialectical principles? One of them is the principle of the unity of opposites. For example, if I say, "John Smith is a man," I am asserting the identity in a certain context of a particular, John Smith, and the universal, man. This identity has led philosophers into very great difficulties for the last 2,300 years. Again, I say that the wood of which this table is made is hard, or it would not support things, and soft, or it could not be cut. Two opposite qualities are united. Before such assertions, we have two alternatives; we may say, as Plato said, that matter is something self-contradictory, it is and is not. Universals are real, but matter is unreal.

Or we may say with Engels that matter unites these opposites. This means that matter is some thing very much richer and more complicated than the mechanistic materialists had ever dreamed.

Two remarks may be made on this principle. Lenin wrote that the unity of opposites is something conditional and temporary. Gas has no hardness, in the sense that it will put up no permanent resistance to division. On the other hand, it is probable that an electron is absolutely hard in the sense of being completely indivisible.

At any stage in the development of science we can undoubtedly explain away contradictions which puzzled our ancestors. For example, today, instead of saying, like Plato, that a table is both hard and soft, we can ascertain by a number of measurements the degree of hardness of the wood, its breaking strain, and so on.

There are a number of things which were Paradoxical to Plato and are not to us. On the other hand, in our own time new contradictions have appeared which seem just as trying to us as contradictions which we find trivial appeared to Plato. For example, electrons have apparently at the same time properties which compel us to regard them as particles, and other properties which can be explained if they are systems of waves. Two thousand years from now, these difficulties may seem very elementary indeed, but I think that our descendants will probably still be finding opposites embodied in matter which they will find difficult to unify.

The second principle is the passage of quantity into quality, and conversely. This phrase is taken from Hegel, but a much more satisfactory account of what is meant by it is given by Marx [C.(I), p. 337] in Capital.

"Here, as in natural science, is verified the correctness of the law discovered by Hegel in his 'logic' that merely quantitative changes beyond a certain point pass into qualitative differences."

A classical example of this is the boiling or freezing of water, but any other change of phase in physical chemistry may be taken as an example. At the boiling point of water some of its measurable qualities show an abrupt break. The volume, which has been going up steadily but slowly, shoots up enormously. Other properties disappear; for example, the capacity for dissolving solutes and that of ionizing salts.

The principle is, of course, absolutely fundamental in physiology. A hundred years ago it was commonly said that carbon dioxide was a poison, because a man died if he breathed pure carbon dioxide. Then J. S. Haldane found that a certain amount of this substance was essential for life. The normal amount in the blood corresponds to a pressure of about 5 per cent of an atmosphere. If this is either doubled or halved serious symptoms arise. In fact, too much of it is a poison, but a certain amount is a necessity.

It is equally fundamental in such ethical systems as that of Aristotle, who pointed out that the
difference between good and evil was largely quantitative. Thus the coward took too few risks, the rash man too many, and the brave man the right number. It is even familiar in law, where for example, three or more people can make a riot, but one or two cannot.

In modern physics it is familiar under the name quantization. Not only mass, but energy, can only be transferred from one system to another (at least in certain cases) in definite quantities. We shall deal with his matter in more detail in Chapter 3. It may well be that quantum phenomena are the most fundamental and primitive expression of this principle, and that the other examples of it will ultimately be explicable a basis of quantum theory.

Now according to the view of matter which was first clearly formulated by Locke, though it goes back to Descartes and Democritus, the quantitative aspect of matter is real, whilst of its qualities are illusory. Thus what we call colours and tones are "really" only vibration frequencies. For Marxists both quantity and quality are properties of the real world.

The converse transformation of quality into quantity is exemplified when a symphony is recorded on a sound-track. Since our knowledge of the external world depends on the frequencies with which nervous impulses reach our brains and spinal columns along a million or two nerve fibres, and not on qualitative differences in these impulses, this transformation, and the reverse transformation of quantity into quality which takes place in our brains, play a fundamental part in our knowledge of the world.

The social applications of the principle are important. They have been given by Marx in a number of places, and it is worth while pointing out that laws holding right through one state of society may become meaningless in another. Social change may be discontinuous, as in the case of water to steam at atmospheric pressure, or continuous, as in the case of the passage from water to steam at pressures higher than the critical pressure. Thus slavery came to an abrupt and violent end in the United States, but faded out gradually in the late Roman Empire.

A third principle, which is perhaps the most important, is what is called the negation of the negation. Let me give a simple example. I learn to drive a motor-car, and among other things to steer it. Then I drive a little faster than usual, and skid. Skidding is the negation of steering. After skidding a number of times, I learn to control a skid in the direction which I desire. That is a passage to a higher level of motor driving. It is a passage which some drivers never make. London bus drivers, who have to learn to drive in pools of oil, are compelled to make it, and the controlled skid is part of the technique of every racing motorist. I take that example from familiar practice. Examples in physics and biology will follow later on.

One of Marx's examples from economics is interesting as showing how he applied this idea in the economic field. First of all, he describes medieval English industry, in which the workers owned the means of production, their own tools; and in some cases, their own land; but he was particularly concerned with handicraft production. Then, with the development of industry in the early stages of capitalism, the immediate producers were expropriated, ceasing to own their means of production, either forcibly, as through the enclosures of the land, or more generally by the competition of far more efficient industry based on division of labour and on capital. The hand-loom was killed by the factories. This process was the negation of the ownership by the workers of their means of production. But Marx claims that this process is now being negated. In the present stage of capitalism, capital is negating itself. [C. (I), p. 836]

"That which is now to be expropriated is no longer the labourer working for himself, but the capitalist exploiting many labourers. This expropriation is accomplished by the action of the immanent laws of capitalistic production itself, by the centralization of capital. One capitalist always kills many. Hand in hand with this centralization, or this expropriation of many capitalists by few, develop, on an ever extending scale, the co-operative form of the labour process, the conscious technical application of science, the methodical cultivation of the soil, the transformation of the instruments of labour into instruments of labour only usable in common, the economizing of
all means of production by their use as the means of production of combined socialized labour....

Along with the constantly diminishing number of the magnates of capital, who usurp and monopolize all advantages of this process of transformation, grows the mass of misery, oppression, slavery, degradation, exploitation; but with this too grows the revolt of the working class, a class always increasing in number, and disciplined, united, organized by the very mechanism of the process of capitalist production itself. The monopoly of capital becomes a fetter upon the mode of production, which has sprung up and flourished along with, and under it. Centralization of the means of production and socialization of labour at last reach a point where they become incompatible with their capitalist integument. This integument is burst asunder. The knell of capitalistic private property sounds. The expropriators are expropriated."

That is the way in which Marx conceived of e development of capitalism, its self-destruction, and the coming of socialism.

Now the negation of the negation was regarded by Marx as the main source of progress and of novelty. A great many philosophers, for example, Lloyd Morgan and Smuts, have recently been interested in what they call the emergence of novelty.

Lenin wrote:

"Two fundamental (or is it the two possible? or is it the two historically observed?) conceptions of evolution are: development as decrease and increase as repetition; and development as a unity of opposites (the division of the one into mutually exclusive opposites and their reciprocal correlation). The first conception is dead, poor, and dry; the second is vital. It is only this second conception which offers the key to understanding the 'self-movement' of everything in existence; it alone offers the key to understanding 'leaps,' to the 'interruption of gradual succession,' to the 'transformation into the opposite,' to the destruction of the old and the appearance of the new." [M.E., p. 323 (manuscript notes)]

We shall have to see how far this rather ambitious claim can be verified in the field of science.

Above all, dialectical materialism insists on the reality of change. It claims to go back beyond Plato and Socrates to Heraclitus, and in particular it welcomed the new developments of physics which seemed to some to spell the end of materialism, and which undoubtedly were the end of the very narrow forms of materialism current in many scientific circles at the end of the nineteenth century, and still current in some of them.

As we saw above, Lenin wrote: [M.E., p. 220]

"The sole 'property' of matter--with the recognition of which materialism is vitally connected--is the property of being objective reality, of existing outside our cognition."

And for that reason, he was very far from upset by the revolutionary physical discoveries of his time.

Again, Engels [F., p. 51] said:

"The great basic thought that the world is not to be comprehended as a complex of ready-made things, but as a complex of processes, in which the things apparently stable no less than their mind-images in our heads, the concepts, go through an uninterrupted change of coming into being and passing away, in which, in spite of all seeming accidents and all temporary retrogression, a progressive development asserts itself in the end--this great fundamental thought has, especially since the time of Hegel, so thoroughly permeated ordinary consciousness that in this generality it is scarcely ever contradicted. But to acknowledge this fundamental thought in words and to apply it in reality in detail to each domain of investigation are two different things."

You will see that in the idea of process as fundamental, we have the anticipation of much of what is valuable in the philosophies of Bergson and Whitehead. Later on I hope to show how these principles work, or at least to examine whether they work, in the field of science.
I am perfectly aware that my approach has been extremely incomplete. If anyone wishes to study the matter in detail, I would recommend them to read *Feuerbach* and *Anti-Duhring*, remembering that they were written from the point of view of the science of sixty years ago, and that therefore certain of the statements made in them would obviously have to be modified to meet recent developments of science.

An important type of dialectical process is as follows. We study some thing or some process in isolation. We produce a theory and we find that that theory is unsatisfactory because we have ignored the background. Now afterwards it is very easy for any critic to say, "Well, your original theory was just a piece of absurdity. Anyone could tell that it wasn't going to work!" Unfortunately, in practice we find that until we had produced the theory which worked up to a point and then broke down, we could not tell what elements we had ignored and should not have ignored. Let us take an example from chemistry. In the Middle Ages, no self-respecting alchemist would have dreamed of doing any chemical process which was in any way difficult without first observing the position of the planets. For example, if it was an operation involving tin, he would presumably have seen that the experiment was begun when Jupiter was in the ascendant, because Jupiter was the planet presiding over tin. One of the greatest steps in chemical progress ever taken was when some bold man actually began making experiments without first observing the planets, and found that they were just as successful as before. Nevertheless, when chemical theory and practice progressed, it was found that there were certain things in the background which could not be ignored, things of which the medieval alchemists had never even dreamed. For example, it is clear that in any chemical experiment involving the measurement of the amount of gas produced, it is necessary to read not only the thermometer, but the barometer; and it is only when one takes account of the variations in the barometric pressure that one gets anything like exactitude in such measurements.

Now this increasing importance of the background is often a part of the historical process. For example, in what we believe to be the most primitive type of human life known to us, the collecting stage, which comes even before the stage of hunting, it is clear that the most effective community was the family. The same is still true of a society based on very simple hunting and fishing. In that stage of human development, the only sensible philosophy was anarchism—let your neighbour alone. Larger communities, however, are necessitated by denser populations due to more effective production, and some form of organization above the family becomes necessary. You can no longer neglect the background of other human families.

In the same way it is believed by many people that whereas a hundred years ago the national state could be regarded to a very considerable extent in isolation, that is now no longer possible, owing to the great development of transport, including the transport not only of men and merchandise, but also of bombs.

There is a special case which arises when the situation is altered by our own knowledge of it. Engels attributed to Hegel the statement: "Freedom is the recognition of necessity." I think that actually the first man who made that statement was not Hegel, but Spinoza. It is a paradox, but in many cases it is true. Let us take the following statement: "If you drink water polluted with *Bacillus typhosus*, you will probably get typhoid fever." That statement is substantially true, until we recognize that it is true, and take action based upon it. Until its truth was recognized, men tried all sorts of methods of dealing with typhoid epidemics; magic, power, war on bad smells, and so on, without very conspicuous success. Now the curious thing is that when that statement regarding typhoid was not only put forward, but was made the basis of action, it ceased to be true. It immediately became a lie, because you have to add to the words "you will probably get typhoid fever," "but not if your water is boiled or chlorinated, or if you get yourself immunized." In other words, by recognizing the necessity, you are able in that case and in many others to circumvent it.

The same thing is true of the doctrine of historical materialism. It may be claimed, in my opinion with a very large measure of truth, that man is to a considerable extent a slave of economic conditions, until he recognizes the fact; and the idealist, who denies the principle of historical
materialism completely, is as much in the grip of economic conditions as anyone else. Marxists believe that the principle of economic determinism of other human activities is largely true, but they are out to make it untrue by founding a society in which economic classes have been abolished, and in which this particular kind of determinism no longer holds.

Of course, no Marxist would claim that before Marx's time no one struggled against economic conditions. On the contrary, almost if not quite all the political struggles of the past were at bottom struggles against economic conditions. The struggle was often unconscious, but sometimes fully conscious. But the participants in these past struggles concentrated on their immediate problems, and did not see them in their full historical perspective. The fact that Marxism lays so much stress on this struggle of human beings against economic forces makes it clear that the doctrine of economic fatalism is no part of the Marxist philosophy. On the contrary, Marxism unifies the theory of the struggle against economic fatalism with its actual practice.

The above is a very characteristic type of dialectical process, on which Professor Levy has laid particular stress in a number of papers and a recent book. *A Philosophy for a Modern Man*, Alfred A. Knopf, 1938

Before we pass on, I want to compare this Hegelian-Marxist dialectic for one moment with that of Socrates, who may be said to have introduced the dialectical method into philosophy.

So far as we can make out, the Socratic method of operation was as follows: he started a conversation with some unfortunate Athenian citizen on a topic such as the nature of justice, and made his unlucky and unsuspecting interlocutor contradict himself. As a result of those contradictions, he arrived, if not at the truth, at any rate somewhat nearer the truth than his starting-point.

Plato wrote that the dialectical method was a means of arriving at absolute truth. For example, if the question discussed was, "What is Justice?" Plato thought that justice corresponded with some eternal idea, and that by examining the ordinary man's idea of justice, showing where it contradicted itself, and in consequence amending it so that it was no longer self-contradictory, he could arrive at a knowledge of that eternal idea of justice. We now, most of us, doubt whether Plato was correct; and there has been a tendency, especially perhaps among scientific people, to say that Socrates was merely investigating the meaning of words, and doing something pretty unimportant. I believe that this view is also incorrect. The word "justice" in Athens stood, if not for an eternal idea, at any rate for a social reality for which men were willing to die or to kill. But justice in Athens, even justice as conceived by the most enlightened Athenian, was by no means the same as justice in England today. Very few, if any, of Socrates' interlocutors would have regarded slavery as an essentially unjust institution; and in the same way, justice in twentieth-century England presumably means something different from what it will mean a hundred years hence.

We may conclude then, that while this verbal or argumentative dialectical process can take us a certain way, can clarify our ideas to a considerable extent, yet history applies a dialectical process of a far more searching character to our social institutions, bringing out contradictions which no amount of mere argument would have disclosed.

The Marxist theory of truth is, I think, straightforward and simple, but by no means complete. The view taken is that an indefinite progress is made in the direction of truth, except, perhaps, on fairly trivial matters such as the date of a given man's birth or death. This doctrine is, of course, familiar to English students of philosophy in a slightly different form in the work of Bradley. A short quotation from Engels [A.D., p. 101] states the Marxist point of view clearly:

"The sovereignty of thought is realized in a series of extremely unsovereignly-thinking human beings; the knowledge which has an unconditional claim to truth is realized in a series of relative errors; neither the one nor the other can be fully realized except through an endless eternity of human existence."
"Here once again we find the same contradiction as we found above, between the character of human thought, necessarily conceived as absolute, and its reality in individual human beings with their extremely limited thought. This is a contradiction which can only be solved in the infinite progression, of what is for us, at least from a practical standpoint, the endless succession, of generations of mankind. In this sense human thought is just as much sovereign as not sovereign, and its capacity for knowledge just as much limited as unlimited. It is sovereign and unlimited in its disposition, its vocation, its possibilities and its historical purpose; it is not sovereign and it is limited in its individual expression and in its realization at each particular moment.

"It's just the same with eternal truths. If mankind ever reached the stage at which it could only work with eternal truths, with conclusions which possess sovereign validity and have an unconditional claim to truth, it would then have reached the point where the infinity of the intellectual world both in its actuality and in its potentiality had been exhausted, and this would mean that the famous miracle of the infinite series which has been counted would have been performed."

On the whole we may take it that Marxists are rather sceptical of the more ambitious logical theories. For example, the system of Russell and Whitehead, in the *Principia Mathematica* is doubtless true, or largely true, if sufficiently sharp classification is possible.

It is, of course, based on the hypothesis that existents (e.g. dogs, lightning flashes, and sensations), relations (e.g. greater than, father of, desired by), and propositions (e.g. this hat is black, all pigs have heads, I want a drink), can be arranged in classes. Then, for example, if a one to one correspondence can be made between the members of two classes, say the bright stars in the Plough and the petals of a typical Purple Loosestrife flower, these two classes are members of a class which also includes the class of days in the week and the class of dwarfs who befriended Snow White. This super-class is the number seven. And on this basis the fundamental theorems of mathematics can be proved.

If then we can divide up all animals precisely into different species, between which the distinctions are at all times well marked, no doubt the Russell-Whitehead theory of classification will hold. But actually this division of animals into species or other higher categories is by no means universally valid. The gap between species is bridged not only by evolution in the past, but in some cases at any rate, by hybridization in the present. Engels made very great play with animals which bridged gaps—*Archaeopteryx*, which bridged the gap between reptiles and birds, and *Ceratodus*, bridging to some extent the gap between the fish and the amphibia, though, of course, far less completely than many fossil forms since discovered. For that reason it is probable that too great emphasis has been attached to logical systems which will only work for material that has certain highly abstract properties, which are rather less frequently and much less completely exemplified in the real world than logicians would like to think.
M.I.A. Library: John Burdon Sanderson Haldane

JBS Haldane
1892-1964

Biography

Writings:
Daedalus, or, Science and the Future, 1923
On Being the Right Size, 1928
Science and the Supernatural: A correspondence between Arnold Lunn and J. B. S. Haldane, 1931-
ONE of the questions on which clarity of thinking is now most necessary is that of the relation between the methods of science and of Marxist philosophy. Although much has already been written on the subject, yet there is still an enormous amount of confusion and contradictory statement. It is widely felt outside Marxist circles that, whatever the economic and political value of Marxist teaching, its incursion into the field of science is unwarranted. This is most strongly felt in relation to natural science, but it extends also to the social sciences in so far as these tend to imitate in their techniques the methods of natural science. Marxism is taken to be just another philosophic intrusion, adding nothing of importance and essentially superfluous in a region where the existing development of scientific method gives all the analysis which is necessary for the understanding of...
nature. Such an attitude, which has indeed been held by many who call themselves Marxists, implies at best a superficial view of Marxism and a lack of appreciation of its comprehensive nature. Much of this misunderstanding arises, particularly among those who have been trained in the English empirical tradition, from the fact that Marxist philosophy arose in part from Hegel and still retains a Hegelian terminology. The new direction which Marx gave to Hegelian philosophy and the solid material basis which he established for it are neither understood nor appreciated by those who are frightened by the phrases of "the transformation of quantity into quality" or "the negation of the negation." Those writers, on the other hand, who have attempted to remove from dialectic materialism its particular terminology generally also succeeded in removing the specific contributions which it has made to the understanding of the process of the universe and reduce it to a merely generalized application of normal scientific method. Now Marxism is not scientific method, nor is it in any sense an alternative method; it is at the same time more comprehensive and more advanced. Both the method of science as hitherto understood and the content of scientific discovery can be incorporated in the Marxist scheme. They need, however, to be criticized and extended. Marxism is no substitute for science, but because of its wider scope it can see the limitations of exiting methods and indicate where in the past these have been used in fields in which they have no competence. Further, it serves to complete the picture given by science by introducing into it a number of concepts and methods of working which have been, for historical and technical reasons, up till now foreign to it--and lastly to show science that its social function is not only contemplative but active. This is not to be taken to mean that Marxism is not science or that it is something which could be added on to science; or to set up an antithesis between Marxism and science. Marxism transforms science and gives it greater scope and significance, but we are not concerned here so much with this transformed Marxist science as with science as it is today.

One of the special features of Marx's work, which at first sight would seem to be an indication of the impossibility of the claims here advanced, was that he derived his analysis of the universe from the study of the development of human society. Human society is intrinsically more complex than any other part of nature, not only because it contains in itself all its complexities and more, but because its changes are more rapid and less regular. It is no accident that the sciences purporting to deal with it were the last to develop and are still the most unformed. Now science has proceeded almost axiomatically on the ground that the complicated is to be understood in terms of the simple and not vice versa. In doing so, however, especially in establishing those regularities which we know as scientific laws, it has necessarily deprived itself of the possibility of examining the type of phenomena that are not regular, particularly the appearance of novel elements in the universe. Now the rate of appearance of novelty is itself the function of the complexity of the phenomena. We have no reason to believe that the vibrations of electrons in an atom of hydrogen have been for the last 10^10 years different from what they are observed to be now. The progress of science, beginning with physics and working upwards to biology, did rest on the tacit assumption which was that of Aristotle and Averroes, that everything in the universe had proceeded and did proceed by unvarying and eternal rules. Anything therefore which did not depend on such rules was ipso facto excluded from the realm of science. Human history, for instance, was considered, except by aberrant intellects like Vico, to be an art and not a science. Even the cosmic evolution of Laplace did not seriously shake this position, because in his scheme it took place only as the result of the rigid application of the eternal Newtonian laws of motion. It was this attitude in fact which prevented for many hundreds of years the acceptance of the intrinsically obvious theory of organic evolution. But the evolution of new forms in the living world still remained as it remains largely today, a matter of inference and not of direct observation. The bulk of biological work on evolution has been rather to establish its reality and map out its line of advance than to inquire as to why it occurs at all. It is in fact only in the phenomena of our own society that we are able to see the development of radically new things occurring under our eyes, and if we are to understand how new things are produced in the universe it can only be, in the first place through such a study.

The way in which thinkers have approached the problem of history has gone through very curious
and significant changes. In early times history was considered first as a storehouse of nobility and tribal self-glorification, and then for its value in moral edification. The first theories of history were justifications of the ways of God with men. It gradually appeared to the rationalists of the eighteenth century that this was not good enough, that making Providence responsible for everything in fact explained nothing. But they were not able to put anything very satisfactory in its place. The degradation of mankind through the appearance of wealth, kings, and priests was only a repetition on another plane of the story of the Fall. The scientific historians of the nineteenth century preferred to have no theory of history at all, and it degenerated into a chronicling of events which ceased to have any justification except giving employment to its professors. This was not entirely mental laziness; it betrayed a half-conscious apprehension that if people inquired too closely into the forces of human development they might find things inimical to the existing order.

Being from the outset free from this fear, Marx was able to see more in history than a meaningless sequence of events or vague tendencies towards progress. It was clear to him that he was not dealing with a unitary movement towards some foredestined end, but with conflicts which were resulting in the creation of new forms. The initial difficulty however remained, that before anything adequate could be discovered about the laws of these movements the phenomena themselves had to be ordered and grouped. It was for this purpose that he used the philosophy of his youth, though in doing so he transformed the most essential parts of the Hegelian world concepts. Hegel had introduced a most valuable and convenient classification. He saw the world in a hierarchical order. In other words, he was aware that the progress from simplicity to complexity is not an undifferentiated increase but can be divided naturally into successive stages, each stage having a general mode of behavior of its own. Each element in the hierarchy includes all those below it and is included in all those above. But the Hegelian hierarchy, because it was one of pure thought, could have no true development in time. The different stages were eternal and instantaneous. Marx, by making his hierarchy material, made it at the same time dynamic and historical. Each higher stage had actually grown out of the lower stage, and the new qualities it possessed were a product of those of the lower stages and of their mode of coming together. Thus the classes of human society are not just stock assemblages of people occupying a certain level in a social ladder but are the product of a tribal organization destroyed and reformed by the development of economic relations which had arisen from the development of the tribal economy itself. The categories with which Marx dealt differ from those used in science in that they are incapable of complete isolation. They must always be considered in relation to their origin and to their future development.

Now as science itself has proceeded almost entirely by the method of isolation and precise definition of categories independent of time, the Marxist method of thinking has appeared loose and unscientific, or as most scientists would put it, metaphysical. Isolation in science however can only be achieved by a rigorous control of the circumstances of the experiment or application. Only when all the factors are known is scientific prediction, in the full sense, possible. Now it is quite clear that were new things are coming into the universe all the factors cannot be known, and therefore that the method of scientific isolation fails to deal with these new things. But from the human point of view it is as necessary to be able to deal with new things as with the regular order of nature. It is perfectly right to restrict the use of the scientific method as it exists to the latter, but it is wrong to imply that outside this regular order the human mind is helpless, that if something cannot be dealt with "scientifically" it cannot be dealt with rationally. The great contribution of Marxism is to extend the possibility of the understanding and control of phenomena to include those in which radically new things are happening. This can only be done, however, subject to certain necessary limitations. In the first place, the degree of prediction where new things are concerned can never be of the same order of exactitude as in the regular and isolated operations of science. Exact knowledge which has been looked on as an ideal is however not the only alternative to no knowledge at all. There are, of course, very large regions inside science itself where exact knowledge is impossible. The whole trend of modern physics has shown that it is hopeless to expect it in atomic phenomena. But there the difficulty is circumvented by relying on the exactness of the statistical knowledge of a large
number of events, and abandoning any claim to prediction of particular events. The exact dates and locality of the critical changes, the wars and revolutions that affect human society, are also unpredictable, and as there is only one human society even statistical methods are not strictly applicable. Nevertheless, the instability of certain economic and political systems call be shown to be due to intrinsic factors, and their breakdown becomes, within a wide limit of years, inevitable.

There can be no question, even to those completely unaware of the methods by which these predictions are reached, that the Marxists have some way of analyzing the development of affairs that enables them to judge far in advance of "scientific" thinkers what the trend of social and economic development is to be. The uncritical acceptance of this, however, leads many into believing that Marxism is simply another Providential theology, that Marx had mapped the necessary lines of social and economic development which men willy nilly must follow. This is a complete misunderstanding: Marxist predictions are not the result of working out such a scheme of development. On the contrary, they emphasize the impossibility of doing this. What can be seen at any given moment is the composition of the economic and political forces of the time, their necessary struggle and the new conditions which will arise as a result of it. But beyond that we can only foresee a process which has not ended and will necessarily take on new and strictly unpredictable forms. Marxism is valuable as a method and a guide to action, not as a creed and a cosmogony.

The relevance of Marxism in the development of science is both theoretical and practical. It removes science from its imagined position of complete detachment and shows it as part, a critically important part, of economic and social development. The complete revolution of the history of science as the result of Marxist analysis, so brilliantly summarized in Professor Hogben's article in SCIENCE & SOCIETY, is one of the first results of this new attitude. But for Marxism understanding is inseparable from action, and the appreciation of the social position of science leads at once in a socialist country, such as the U.S.S.R., to the organic connection of scientific research with the development of socialized industry and human culture. The organization of science in capitalist countries has gradually molded itself in the service of big business, but because the process is not understood or appreciated its service is poor and incredibly wasteful. In any case production for profit can never develop the full potentialities of science except for destructive purposes. The Marxist understanding of science puts it in practice at the service of the community and at the same time makes science itself part of the cultural heritage of the whole people and not of an artificially selected minority.

The direct application of Marxism to scientific research is still very ill understood. It is clear that the scientific method as explicitly taught, while valid in establishing connections between phenomena, offers in itself no way of arriving at those connections. This fact is conveniently slurred over in scientific literature. In every scientific paper the data are given, the arguments from the data to the conclusions, and the conclusions themselves. What is not given, in general, is how the investigator chose the problem and how he thought of deriving the conclusions, and when reasons are given they are very rarely those actually used in the research but rather the formalized version of what the procedure of an ideal rational man would be in the circumstances. The whole drive of scientific inquiry is left implicitly to be explained by the operations of genius or intuition. The scientist actually does think of the new things, and it is no one's business to inquire why he does. This is where dialectical materialism comes in. Its value is not merely critical, as is classical scientific method, but indicative. It points the way in which it may be useful to look for new solutions. It is able to do this because of its way of linking up different aspects of nature under its general categories. It is extremely difficult to give examples because of the complexity of all the processes of scientific discovery, but from my own experience I have found Marxist methods invaluable for arriving at new conceptions. In the theory of liquids, for instance, we have to deal with phenomena that are not resolvable into the reaction of a particle with a certain environing force field but are strictly collective phenomena in which we have to consider at the same time the behavior of every particle and their mutual relations. It will be possible, when some systematic mind has been able to
work on the subject, to develop out of the Marxist analysis a number of common scientific modes with some indication of which should be invoked in different circumstances. Collective behavior will obviously be one of these, another will be what might be called nuclear phenomena where the beginning of anything from the crystal to a revolution depends on a local assemblage of peculiarly favorable circumstances which alone enable it to get through the critical stages before which it is too small to grow.

Marxism has still another connection with science, that of criticizing its philosophic bases and the implications which seem to arise from the internal development of science itself. Marx, Engels and Lenin were all deeply concerned with this question, and for Marxist scientists of our time, though they have been distracted by the immediate needs of the economic situation in the Soviet Union or by the political situation outside it, it still remains a task of the greatest importance. On the fringe of science, and to the layman indistinguishable from it, are the pronouncements which the scientist makes on questions which are felt to be of vital human interest--those of the origin and fate of the universe, the nature of life, the character and behavior of the human mind and of society. In nearly every case the exact analysis of the statements reveals them as having little factual content, and in most cases they represent the dressing up of old traditional metaphysical ideas in the language, though not in the sense, of modern discovery. Such conceptions can be ruthlessly exposed and criticized from the Marxist point of view, because they represent entirely illegitimate use of science. One particular method of argument which is extremely common nowadays is that which establishes the existence of the supernatural from our ignorance of the natural. It is just in those spheres of science where the least exact knowledge exists that the strongest attempts are made to use science to bolster up ancient superstitions. Fortunately, it is just in such places that Marxist methods of attack are most valid, because they are all places where new things are being produced and where isolation so common in scientific research most palpably breaks down. These were all questions to which Marx and Engels devoted particular attention, and the way in which they were able to anticipate the trends of discovery in these fields is a striking indication of the value of the dialectical method. The modern Marxists have before them far vaster and more complex problems than had the pioneers. It seems probable that in the face of them modern science may well reach an impasse comparable with that which overcame the science of classical times. It is for the Marxists to find new methods of thought, of scientific organization and material technique which will prevent this happening.

The four critical points of the modern world view of science are the basic concepts of physics, which are now indissolubly bound up with the origin of the universe, the origin of life, the origin of human society and the fate of human civilization. In the first field it is more than ever clear that physics and astronomy are at present in an impasse. The contradictions between theory and observation in the field of cosmic rays, the expanding universe and the relation between fundamental physical units can no longer be obscured. Such contradictions are of course of enormous value to science, because out of the struggle to solve them will emerge some new and further-reaching generalizations, but until this happens no inferences can logically be made as to such ultimate questions; and even when it does, it can only be raising further and hitherto unglimpsted problems. Nevertheless, it is just this ignorance which is being used by the mystical physicists and astronomers to build a new creation myth. Just because the physicist cannot say, because the laws are not sufficiently well known, how the universe developed into its present state, they infer that it must have been created, as if this explanation did not raise enormously greater difficulties. From the Marxist point of view the problem of the origin of the universe in any ultimate sense is a pointless one. At any given stage the necessity of development of certain forms--stars, galaxies--may be derivable from the internal contradictions of some previous state, but there is no necessity to postulate either the eternal existence of a universe essentially like ours or a single ultimately primitive state. Indefinite regression of opposition and synthesis remains before us to explore.

The result of the progress of science in the last few centuries has been to progressively reduce the amount of work which the gods or God have had to do, but even yet the logical conclusion is not
drawn. Evolution removed the necessity for special creation, but it is still considered that the Creator must have intervened to start the process off. Life appears as so qualitatively different from dead matter as to require some special act in its production. This problem again seems unreal to the Marxist, not that he denies the qualitative difference but that he sees in its origin just another example of that transformation of quantity to quality that is the characteristic of the appearance of new things. Life is sharply marked off from non-life, largely because its own operations effectively destroy the possibility of its continual recreation. In the primitive, lifeless world chemical substances were accumulated of the kind that cannot accumulate now because they would be consumed by the very life which their coming together in special circumstances brought into being. The practical scientists of today are learning to manipulate life as a whole and in parts very much as their predecessors of a hundred years ago were manipulating chemical substances. Life has ceased to be a mystery and has become a utility.

There yet remain the problems of man. The nineteenth century evolutionists certainly went too far in their demonstration that man was but a modified ape. The theologians were right in feeling that in this explanation something had been left out, but the soul which they postulated was again one of these mystical explanations which explain nothing. What Marx and Engels saw was the real qualitative difference between man and the animals was not the mere possession of a larger brain but the organization of human society; that human society was a category definitely different and higher than the animal species; that man in society represented a qualitatively new thing in the universe. The whole of modern anthropological and psychological research reinforces this conclusion: man is man-made, individually in the family, and socially through tradition and history, molded by his economic necessities and the means he has found to satisfy them.

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**Footnotes**


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**Marxist Writers**

**Lev Vygotsky**

**The Historical Meaning of the Crisis in Psychology: A Methodological Investigation**

**Written:** 1927;
**Source:** The Collected Works of Vygotsky;
**Publisher:** Plenum Press, 1987;
**Translated:** translated Rene Van Der Veer;
**Transcribed:** Andy Blunden;
**HTML Markup:** Andy Blunden.
1: The Nature of the Crisis

Lately more and more voices are heard proclaiming that the problem of general psychology is a problem of the first order. What is most remarkable is that this opinion does not come from philosophers who have made generalisation their professional habit, nor even from theoretical psychologists, but from the psychological practitioners who elaborate the special areas of applied psychology: psychiatrists and industrial psychologists; the representatives of the most exact and concrete part of our science. The various psychological disciplines have obviously reached a turning
point in the development of their investigations, the gathering of factual material, the
systematisation of knowledge, and the statement of basic positions and laws. Further advance along
a straight line, the simple continuation of the same work, the gradual accumulation of material, are
proving fruitless or even impossible. In order to go further we must choose a path.

Out of such a methodological crisis, from the conscious need for guidance in different disciplines,
from the necessity – on a certain level of knowledge – to critically coordinate heterogeneous data,
to order uncoordinated laws into a system, to interpret and verify the results, to cleanse the methods
and basic concepts, to create the fundamental principles, in a word, to pull the beginnings and ends
of our knowledge together, out of all this, a general science is born.

This is why the concept of a general psychology does not coincide with the concept of the basic
theoretical psychology that is central to a number of different special disciplines. The latter, in
essence the psychology of the adult normal person, should be considered one of the special
disciplines along with zoopsychology and psychopathology. That it has so far played and in some
measure still plays the role of a generalising factor, which to a certain extent forms the structure and
system of the special disciplines, furnishes their main concepts, and brings them into line with their
own structure, is explained by the historical development of the science, rather than by logical
necessity. This is the way things have been and to some extent still are, but they should not and will
not remain this way since this situation does not follow from the very nature of the science, but is
determined by external, extraneous circumstances. As soon as these conditions change, the
psychology of the normal person will lose its leading role. To an extent we are already beginning to
see this happen. In the psychological systems that cultivate the concept of the unconscious, the role
of such a leading discipline, the basic concepts of which serve as the starting points for the related
sciences, is played by psychopathology. These are, for example, the systems of Freud, Adler, and
Kretschmer.

In the latter, this leading role of psychopathology is no longer connected with the central concept of
the unconscious, as in Freud and Adler, i.e., not with the actual priority of the given discipline in the
elaboration of the basic idea, but with a fundamental methodological view according to which the
essence and nature of the phenomena studied by psychology can be revealed in their purest form in
the extreme, pathological forms. We should, consequently, proceed from pathology to the norm and
explain and understand the normal person from pathology, and not the other way around, as has
been done until now. The key to psychology is in pathology, not only because it discovered and
studied the root of the mind earlier than other branches, but because this is the internal nature of
things, and the nature of the scientific knowledge of these things is conditioned by it. Whereas for
traditional psychology every psychopath as a subject for study is more or less – to a different degree
– a normal person and must be defined in relation to the latter, for the new systems each normal
person is more or less insane and must be psychologically understood precisely as a variant of some
pathological type. To put it in more straightforward terms, in certain systems the normal person is
considered as a type and the pathological personality as a variety or variant of this main type; in
others, on the contrary, the pathological phenomenon is taken as a type and the normal as one of its
varieties. And who can predict how the future general psychology will decide this debate?

On the basis of such dual motives (based half on facts, half on principle) still other systems assign
the leading role to zoopsychology. Of this kind are, for example, the majority of the American
courses in the psychology of behaviour and the Russian courses in reflexology, which develop their
whole system from the concept of the conditional reflex and organise all-their material around it. A
number of authors propose that animal psychology, apart from being given the actual priority in the
elaboration of the basic concepts of behaviour, should become the general discipline with which the
other disciplines should be correlated. As the logical beginning of a science of behaviour, the
starting point for every genetic examination and explanation of the mind, and a purely biological
science, it is precisely this science which is expected to elaborate the fundamental concepts of the
science and to supply them to kindred disciplines.
This, for example, is the view of Pavlov. What psychologists do can in his opinion have no influence upon animal psychology, but what zoopsychologists do determines the work of psychologists in a very essential way. The latter build the superstructure, but the former lay the foundation [Pavlov, 1928, Lectures on Conditioned Reflex]. And indeed, the source from which we derive all our basic categories for the investigation and description of behaviour, the standard we use to verify our results, the model according to which we align our methods, is zoopsychology.

Here again the matter has taken a course opposed to that of traditional psychology. There the starting point was man; one proceeded from man in order to get an idea of the mind of the animal. One interpreted the manifestations of its soul by analogy with ourselves. In so doing, the matter was by no means always reduced to a crude anthropomorphism. Serious methodological grounds often dictated such a course of research: with subjective psychology it could not be otherwise. It regarded man as the key to the psychology of animals; always the highest forms as the key to the lower ones. For, the investigator need not always follow the same path that nature took; often the reverse path is more advantageous.

Marx [MECW Vol 27] referred to this methodological principle of the “reverse” method when he stated that “the anatomy of man is the key to the anatomy of the ape.”

The allusions to a higher principle in lower species of animals can only be understood when this higher principle itself is already known. Thus, bourgeois economy gives us the key to antique economy etc., but not at all in the sense understood by the economists who slur over all historical differences and see bourgeois forms in all forms of societies. We can understand the quit-rent, the tithe, etc., when we are acquainted with the ground rent, but we must not equate them with the latter.

To understand the quitrent on the basis of the ground rent, the feudal form on the basis of the bourgeois form – this is the same methodological device used to comprehend and define thinking and the rudiments of speech in animals on the basis of the mature thinking and speech of man. A certain stage of development and the process itself can only be fully understood when we know the endpoint of the process, the result, the direction it took, and the form into which the given process developed. We are, of course, speaking only of the methodological transference of basic categories and concepts from the higher to the lower, not of the transference of factual observations and generalisations. The concepts of the social category of class and class struggle, for instance, are revealed in their purest form in the analysis of the capitalist system, but these same concepts are the key to all pre-capitalist societal formations, although in every case we meet with different classes there, a different form of struggle, a particular developmental stage of this category. But those details which distinguish the historical uniqueness of different epochs from capitalist forms not only are not lost, but, on the contrary, can only be studied when we approach them with the categories and concepts acquired in the analysis of the other, higher formation.

Marx [MECW Vol 27] explains that

bourgeois society is the most developed and diverse historical organisation of production. The categories which express its relationships and an understanding of its composition yield therefore at the same time an insight into the composition and the productive relations of all societal forms which have disappeared. Bourgeois society was built with the rubbish and elements of these societies, parts of which have not been fully overcome and still drag on and the mere indications of which have developed into full-fledged meanings.

Having arrived at the end of the path we can more easily understand the whole path in its entirety as well as the meaning of its different stages.

This is a possible methodology; it has been sufficiently vindicated in a whole number of disciplines. But can it be applied to psychology? It is precisely on methodological grounds that Pavlov rejects
the route from man to animal. He defends the reverse of the “reverse,” i.e., the direct path of investigation, repeating the route taken by nature. This is not because of any factual difference in the phenomena, but rather because of the inapplicability and epistemic barrenness of psychological categories and concepts. In his words,

it is impossible by means of psychological concepts, which are essentially non-spatial, to penetrate into the mechanism of animal behaviour, into the mechanism of these relations [Pavlov, 1928, Lectures on Conditioned Reflex].

Thus it is not a matter of facts but of concepts, that is, the way one conceives of these facts. He [ibid.] says that

Our facts are conceived of in terms of time and space; they are purely scientific facts; but psychological facts are thought of only in terms of time.

The issue is about different concepts, not different phenomena. Pavlov wishes not only to win independence for his area of investigation, but to extend its influence and guidance to all spheres of psychological knowledge. This is clear from his explicit references to the fact that the debate is not only about the emancipation from the power of psychological concepts, but also about the elaboration of a psychology by means of new spatial concepts.

In his opinion, science, “guided by the similarity or identity of the external manifestations” [ibid.], will sooner or later apply to the mind of man the objective data obtained. His path is from the simple to the complex, from animal to man. He says [ibid.] that

The simple, the elementary is always conceivable without the complex, whereas the complex cannot be conceived of without the elementary.

These data will become “the basis for psychological knowledge.” And in the preface to the book in which he presents his twenty years of experience with the study of animal behaviour, Pavlov [ibid.] declares that he

is deeply and irrevocably convinced that along this path [we will manage] to find the knowledge of the mechanisms and laws of human nature [ibid.].

Here we have a new controversy between the study of animals and the psychology of man. The situation is, in essence, very similar to the controversy between psychopathology and the psychology of normal man. Which discipline should lead, unify, and elaborate the basic concepts, principles, and methods, verify and systematise the data of all other areas? Whereas previously traditional psychology has considered the animal as a more or less remote ancestor of man, reflexology is now inclined to consider man, with Plato, as a “featherless biped.” Formerly the animal mind was defined and described in concepts and terms acquired in the study of man. Nowadays the behaviour of animals gives “the key to the understanding of the behaviour of man,” and what we call “human” behaviour is understood as the product of an animal which, because it walks and stands erect, has a developed thumb and can speak.

And again we may ask: which discipline other than general psychology can decide this controversy between animal and man in psychology; for, on this decision will rest nothing more and nothing less than the whole future fate of this science.

2: Our Approach

From the analysis of the three types of psychological systems we have considered above, it is already obvious how pressing is the need for a general psychology with the boundaries and approximate content partially outlined here. The path of our investigation will at all times be as follows: we will proceed from an analysis of the facts, albeit facts of a highly general and abstract
nature, such as a particular psychological system and its type, the tendencies and fate of different
theories, various epistemological methods, scientific classifications and schemes, etc. We will
examine these facts not from the abstract-logical, purely philosophical side, but as particular facts in
the history of science, as concrete, vivid historical events in their tendency, struggle, in their
concrete context, of course, and in their epistemological-theoretical essence, i.e., from the viewpoint
of their correspondence to the reality they are meant to cognise. We wish to obtain a clear idea of
the essence of individual and social psychology as two aspects of a single science, and of their
historical fate, not through abstract considerations, but by means of an analysis of scientific reality.
From this we will deduce, as a politician does from the analysis of events, the rules for action and
the organisation of scientific research. The methodological investigation utilises the historical
examination of the concrete forms of the sciences and the theoretical analysis of these forms in
order to obtain generalised, verified principles that are suitable for guidance. This is, in our opinion,
the core of this general psychology whose concept we will attempt to clarify in this chapter.

The first thing we obtain from the analysis is the demarcation between general psychology and the
theoretical psychology of the normal person. We have seen that the latter is not necessarily a general
psychology, that in quite a number of systems theoretical psychology itself turns into one of the
special disciplines, defined by another field; that both psychopathology and the theory of animal
behaviour can and do take the role of general psychology. Vvedensky (1917, p. 5) assumed that
general psychology

might much more correctly be called basic psychology, because this part lies at the basis
of all psychology.

Høffding, who assumed that psychology “can be practiced in many modes and ways,” that “there
is not one, but many psychologies,” and who saw no need for unity, was nevertheless inclined to view
subjective psychology “as the basis and the center, around which the contributions of the other
approaches should be gathered.” In the present case it would indeed be more appropriate to talk
about a basic, or central, psychology than about a general one; but to overlook the fact that systems
may arise from a completely different basis and center, and that what the professors considered to
be the basis in those systems, by the very nature of things, drifts to the periphery, would be more
than a little dogmatic, and naively complacent. Subjective psychology was basic or central in quite
a number of systems, and we must understand why. Now it loses its importance, and again we must
understand why. In the present case it would be terminologically most correct to speak of theoretical
psychology, as opposed to applied psychology, as Munsterberg does. Applied to the adult normal
person it would be a special branch alongside child psychology, zoopsychology, and
psychopathology.

Theoretical psychology, Binswanger notes, is not general psychology, nor a part of it, but is itself
the object or subject matter of general psychology. The latter deals with the questions whether
theoretical psychology is in principle possible and what are the structure and suitability of its
concepts. Theoretical psychology cannot be equated with general psychology, if only for the reason
that precisely the matter of building theories in psychology is a fundamental question of general
psychology.

There is a second thing that we may reliably infer from our analysis. The very fact that theoretical
psychology, and later other disciplines, have performed the role of a general psychology, is
conditioned by, on the one hand, the absence of a general psychology, and on the other hand, the
strong need for it to fulfil its function temporarily in order to make scientific research possible.
Psychology is pregnant with a general discipline but has not yet delivered it.

The third thing we may gather from our analysis is the distinction between two phases in the
development of any general science, any general discipline, as is shown by the history of science
and methodology. In the first phase of development the general discipline is only quantitatively
distinct from the special one. Such a distinction, as Binswanger rightly says, is characteristic of the
majority of sciences. Thus, we distinguish general and special botany, zoology, biology, physiology, pathology, psychiatry, etc. The general discipline studies what is common to all subjects of the given science. The special discipline studies what is characteristic of the various groups or even specimens from the same kind of objects. It is in this sense that the discipline we now call differential psychology was called special. In the same sense this area was called individual psychology. The general part of botany or zoology studies what is common to all plants or animals, the general part of psychology what is common to all people. In order to do this the concept of some trait common to most or all of them was abstracted from the real diversity and in this form, abstracted from the real diversity of concrete traits, it became the subject matter studied by the general discipline. Therefore, the characteristic and task of such a discipline was seen to be the scientific study of the facts common to the greatest number of the particular phenomena of the given area [Binswanger].

This stage of searching and of trying to apply an abstract concept common to all psychological disciplines, which forms the subject matter of all of them and determines what should be isolated from the chaos of the various phenomena and what in the phenomena has epistemic value for psychology – this stage we see vividly expressed in our analysis. And we may judge what significance these searches and the concept of the subject matter of psychology looked for and the desired answer to the question what psychology studies may have for our science in the present historical moment of its development.

Any concrete phenomenon is completely inexhaustible and infinite in its separate features. We must always search in the phenomenon what makes it a scientific fact. Exactly this distinguishes the observation of a solar eclipse by the astronomer from the observation of the same phenomenon by a person who is simply curious. The former discerns in the phenomenon what makes it an astronomic fact. The latter observes the accidental features which happen to catch his attention.

What is most common to all phenomena studied by psychology, what makes the most diverse phenomena into psychological facts – from salivation in a dog to the enjoyment of a tragedy, what do the ravings of a madman and the rigorous computations of the mathematician share? Traditional psychology answers: what they have in common is that they are all psychological phenomena which are non-spatial and can only be perceived by the experiencing subject himself Reflexology answers: what they share is that all these phenomena are facts of behaviour, correlative activity, reflexes, response actions of the organism. Psychoanalysts answer: common to all these facts, the most basic factor which unites them is the unconscious which is their basis. For general psychology the three answers mean, respectively, that it is a science of (1) the mental and its properties; or (2) behaviour; or (3) the unconscious.

From this it is obvious that such a general concept is important for the whole future fate of the science. Any fact which is expressed in each of these three systems will, in turn, acquire three completely different forms. To be more precise, there will be three different forms of a single fact. To be even more precise, there will be three different facts. And as the science moves forward and gathers facts, we will successively get three different generalisations, three different laws, three different classifications, three different systems – three individual sciences which, the more successfully they develop, the more remote they will be from each other and from the common fact that unites them. Shortly after beginning they will already be forced to select different facts, and this very choice of facts will already determine the fate of the science as it continues. Kofflka was the first to express the idea that introspective psychology and the psychology of behaviour will develop into two sciences if things continue as they are going. The paths of the two sciences lie so far apart that “it is by no means certain whether they will eventually lead to the same end.”

Pavlov and Bekhterev share essentially the same opinion. They accept the existence of two parallel sciences – psychology and reflexology – which study the same object, but from different sides. In this connection Pavlov [1928, Lectures on Conditioned Reflex] said that “certainly psychology, insofar as it concerns the subjective state of man, has a natural right to existence.” For Bekhterev,
reflexology neither contradicts nor excludes subjective psychology but delineates a special area of investigation, i.e., creates a new parallel science. He talks about the intimate interrelation of both scientific disciplines and even about subjective reflexology as an inevitable future development. Incidentally, we must say that in reality both Pavlov and Bekhterev reject psychology and hope to understand the whole area of knowledge about man by exclusively objective means, i.e., they only envision the possibility of one single science, although by word of mouth they acknowledge two sciences. In this way the general concept predetermines the content of the science.

At present psychoanalysis, behaviourism, and subjective psychology are already operating not only with different concepts, but with different facts as well. Facts such as the Oedipus complex, indisputable and real for psychoanalysts, simply do not exist for other psychologists; for many it is wildest phantasy. For Stern, who in general relates favourably to psychoanalysis, the psychoanalytic interpretations so commonplace in Freud's school and as far beyond doubt as the measurement of one's temperature in the hospital, and consequently the facts whose existence they presuppose, resemble the chiromancy and astrology of the 16th century. For Pavlov as well, it is pure phantasy to claim that a dog remembers the food on hearing the bell. Likewise, the fact of muscular movements during the act of thinking, posited by the behaviourist, does not exist for the introspectionist.

But the fundamental concept, the primary abstraction, so to speak, that lies at the basis of a science, determines not only the content, but also predetermines the character of the unity of the different disciplines, and through this, the way to explain the facts, i.e., the main explanatory principle of the science.

We see that a general science, as well as the tendency of various disciplines to develop into a general science and to spread their influence to adjacent branches of knowledge, arise out of the need to unify heterogeneous branches of knowledge. When similar disciplines have gathered sufficient material in areas that are relatively remote from each other, the need arises to unify the heterogeneous material, to establish and define the relation between the different areas and between each area and the whole of scientific knowledge. How to connect the material from pathology, animal psychology, and social psychology? We have seen that the substrate of the unity is first of all the primary abstraction. But the heterogeneous material is not united merely by adding one kind of material to another, nor via the conjunction “and,” as the Gestalt psychologists say, nor through simply joining or adding parts so that each part preserves its balance and independence while being included into the new whole. Unity is reached by subordination, dominion, through the fact that different disciplines renounce their sovereignty in favour of one single general science. The various disciplines do not simply co-exist within the new whole, but form a hierarchical system, which has primary and secondary centers, like the solar system. Thus, this unity determines the role, sense, meaning of each separate area, i.e., not only determines the content, but also the way to explain things, the most important generalisation, which in the course of the development of the science becomes its explanatory principle.

To take the mind, the unconscious, or behaviour as the primary concept implies not only to gather three different categories of facts, but also to offer three different ways of explaining these facts.

We see that the tendency to generalise and unite knowledge turns or grows into a tendency to explain this knowledge. The unity of the generalising concept grows into the unity of the explanatory principle, because to explain means to establish a connection between one fact or a group of facts and another group, to refer to another series of phenomena. For science to explain means to explain causally. As long as the unification is carried out within a single discipline, such an explanation is established by the causal linkage of the phenomena that lie within a single area. But as soon as we proceed to the generalisation across different disciplines, the unification of different areas of facts, the generalisation of the second order, we immediately must search for an explanation of a higher order as well, i.e., we must search for the link of all areas of the given knowledge with the facts that lie outside of them. In this way the search for an explanatory principle
leads us beyond the boundaries of the given science and compels us to find the place of the given area of phenomena amidst the wider circle of phenomena.

This second tendency, which is the basis of the isolation of a general science, is the tendency toward a unified explanatory principle and toward transcending the borders of the given science in the search for the place of the given category of being within the general system of being and the given science within the general system of knowledge. This tendency can already be observed in the competition of the separate disciplines for supremacy. Since the tendency of becoming an explanatory principle is already present in every generalising concept, and since the struggle between the disciplines is a struggle for the generalising concept, this second tendency must inevitably appear as well. And in fact, reflexology advances not only the concept of behaviour, but the principle of the conditional reflex as well, i.e., an explanation of behaviour on the basis of the external experience of the animal. And it is difficult to say which of these two ideas is more essential for the current in question. Throw away the principle and you will be left with behaviour, that is, a system of external movements and actions, to be explained from consciousness, i.e., a conception that has existed within subjective psychology for a long time. Throw away the concept of behaviour and retain the principle, and you will get sensationalist associative psychology. About both of these we will come to speak below. Here it is important to establish that the generalisation of the concept and the explanatory principle determine a general science only together, as a unified pair. In exactly the same way, psychopathology does not simply advance the generalising concept of the unconscious, but also interprets this concept causally, through the principle of sexuality. For psychoanalysis to generalise the psychological disciplines and to unite them on the basis of the concept of the unconscious means to explain the whole world, as studied by psychology, through sexuality.

But here the two tendencies – towards unification and generalisation – are still merged and often difficult to distinguish. The second tendency is not sufficiently clear-cut, and may even be completely absent at times. That it coincides with the first tendency must again be explained historically rather than by logical necessity. In the struggle for supremacy among the different disciplines, this tendency usually shows up; we found it in our analysis. But it may also fail to appear and, most importantly, it may also appear in a pure form, unmixed and separate from the first tendency, in a different set of facts. In both cases we have each tendency in its pure form.

Thus, in traditional psychology the concept of the mental may be explained in many ways, although admittedly not just any explanation is possible: associationism, the actualistic conception, faculty theory, etc. Thus the link between generalisation and unification is intimate, but not unambiguous. A single concept can be reconciled with a number of explanations and the other way around. Further, in the systems of the psychology of the unconscious this basic concept is not necessarily interpreted as sexuality. Adler and Jung use other principles as the basis of their explanation. Thus in the struggle between the disciplines, the first tendency of knowledge – the tendency towards unification – is logically necessary, while the second tendency is not logically necessary but historically determined, and will be present to a varying degree. That is why the second tendency can be most easily and comfortably observed in its pure form – in the struggle between the principles and schools within one and the same discipline.

3: The Development of Sciences

It can be said of any important discovery in any area, when it transcends the boundaries of that particular realm, that it has the tendency to turn into an explanatory principle for all psychological phenomena and lead psychology beyond its proper boundaries into broader realms of knowledge. In the last several decades this tendency has manifested itself with such amazing strictness and consistency, with such regular uniformity in the most diverse areas, that it becomes absolutely possible to predict the course of development of this or that concept, discovery, or idea. At the same time this regular repetition in the development of widely varying ideas evidently – and with a clarity
that is seldom observed by the historian of science and methodologist – points to an objective necessity underlying the development of the science, to a necessity which we may observe when we approach the facts of science from an equally scientific point of view. It points to the possibility of a scientific methodology built on a historical foundation.

The regularity in the replacement and development of ideas, the development and downfall of concepts, even the replacement of classifications etc. – all this can be scientifically explained by the links of the science in question with (1) the general sociocultural context of the era; (2) the general conditions and laws of scientific knowledge; (3) the objective demands upon the scientific knowledge that follow from the nature of the phenomena studied in a given stage of investigation (in the final analysis, the requirements of the objective reality that is studied by the given science). After all, scientific knowledge must adapt and conform to the particularities of the studied facts, must be built in accordance with their demands. And that is why we can always show how the objective facts studied by a certain science are involved in the change of a scientific fact. In our investigation we will try to take account of all three viewpoints.

We can sketch the general fate and lines of development of such explanatory ideas. In the beginning there is some factual discovery of more or less great significance which reforms the ordinary conception of the whole area of phenomena to which it refers, and even transcends the boundaries of the given group of phenomena within which it was first observed and formulated.

Next comes a stage during which the influence of these ideas spreads to adjacent areas. The idea is stretched out, so to speak, to material that is broader than what it originally covered. The idea itself (or its application) is changed in the process, it becomes formulated in a more abstract way. The link with the material that engendered it is more or less weakened, and it only continues to nourish the cogency of the new idea, because this idea accomplishes its campaign of conquest as a scientifically verified, reliable discovery. This is very important.

In the third stage of development the idea controls more or less the whole discipline in which it originally arose. It has partly changed the structure and size of the discipline and has itself been to some extent changed by them. It has become separated from the facts that engendered it, exists in the form of a more or less abstractly formulated principle, and becomes involved in the struggle between disciplines for supremacy, i.e., in the sphere of action of the tendency toward unification. Usually this happens because the idea, as an explanatory principle, managed to take possession of the whole discipline, i.e., it in part adapted itself, in part adjusted to itself the concept on which the discipline is based, and now acts in concert with it. In our analysis, we have found such a mixed stage in the existence of an idea, where both tendencies help each other. While it continues expanding due to the tendency toward unification, the idea is easily transferred to adjacent disciplines. Not only is it continually transformed, swelling from ever new material, but it also transforms the areas it penetrates. In this stage the fate of the idea is completely tied to the fate of the discipline it represents and which is fighting for supremacy.

In the fourth stage the idea again breaks away from the basic concept, as the very fact of the conquest – at least in the form of a project defended by a single school, the whole domain of psychological knowledge, or all disciplines – this very fact pushes the idea to develop further. The idea remains the explanatory principle until the time that it transcends the boundaries of the basic concept. For to explain as we have seen, means to transcend one's proper boundaries in search of an external cause. As soon as it fully coincides with the basic concept, it stops explaining anything. But the basic concept cannot develop any further on logical grounds without contradicting itself. For its function is to define an area of psychological knowledge. By its very essence it cannot transcend its boundaries. Concept and explanation must, consequently, separate again. Moreover, unification logically presupposes, as was shown above, that we establish a link with a broader domain of knowledge, transcend the proper boundaries. This is accomplished by the idea that separates itself from the concept. Now it links psychology with the broad areas that lie outside of it, with biology, physics, chemistry, mechanics, while the basic concept separates it from these areas. The functions
of these temporarily co-operating allies have again changed. The idea is now openly included in some philosophical system, spreads to the most remote domains of being, to the whole world – while transforming and being transformed – and is formulated as a universal principle or even as a whole world view.

This discovery, inflated into a world view like a frog that has swollen to the size of an ox, a philistine amidst the gentry, now enters the fifth and most dangerous stage of development: it may easily burst like a soap-bubble. In any case it enters a stage of struggle and negation which it now meets from all sides. Admittedly, there had been a struggle against the idea in the previous stages as well. But that was the normal opposition to the expansion of an idea, the resistance of each different area against its aggressive tendencies. The initial strength of the discovery that engendered it protected it from a genuine struggle for life just like a mother protects her young. It is only now, when the idea has entirely separated itself from the facts that engendered it, developed to its logical extremes, carried to its ultimate conclusions, generalised as far as possible, that it finally displays what it is in reality, shows its real face. However strange it may seem, it is actually only now, reduced to a philosophical form, apparently obscured by many later developments and very remote from its direct roots and the social causes that engendered it, that the idea reveals what it wants, what it is, from which social tendencies it arose, which class interests it serves. Only having developed into a world view or having become attached to it, does the particular idea change from a scientific fact into a fact of social life again, i.e., it returns to the bosom from which it came. Only having become part of social life again, does it reveal its social nature, which of course was present all the time, but was hidden under the mask of the neutral scientific fact it impersonated.

And in this stage of the struggle against the idea, its fate is approximately as follows. Just like a new nobleman, the new idea is shown in light of its philistine, i.e., its real, origin. It is confined to the areas from which it sprang. It is forced to go through its development backwards. It is accepted as a particular discovery but rejected as a world view. And now new ways are being proposed to interpret this particular discovery and the related facts. In other words, other world views which represent other social tendencies and forces even reconquer the idea's original area, develop their own view of it – and then the idea either withers away or continues to exist more or less tightly integrated in some world view amidst a number of other world views, sharing their fate and fulfilling their functions. But as an idea which revolutionises the science it ceases to exist. It is an idea that has retired and has received the rank of general from its department.

Why does the idea as such cease to exist? Because operating in the domain of world views is a law discovered by Engels, a law that says that ideas gather around two poles – those of idealism and materialism, which correspond to the two poles of social life, the two basic classes that fight each other. The idea reveals its social nature much more readily as a philosophical fact than as a scientific fact. And this is where its role ends – it is unmasked as a hidden, ideological agent dressed up as a scientific fact and begins to participate in the general, open struggle of ideas. But exactly here, as a small item within an enormous sum, it vanishes like a drop of rain in the ocean and ceases to exist independently.

4: Current Trends in Psychology

Every discovery in psychology that has the tendency to turn into an explanatory principle follows this course. The ascent of such ideas itself may be explained by the presence of an objective scientific need, rooted in the final analysis in the nature of the studied phenomena, as it is revealed in the given stage of knowledge. It can be explained, in other words, by the nature of the science and thus, in the final analysis by the nature of the psychological reality studied by this science. However, the history of the science can only explain why, in a given stage of its development, the need for the ideas developed, why this was impossible a hundred years before. It cannot explain more. Exactly which ideas turn into world views and which not; which ideas are advanced, which path they cover; what is their fate – this all depends upon factors that lie outside the history of the
science and determine this very history.

We may compare this with Plekhanov's (1922) theory of art. Nature has provided man with an aesthetic need, it enables him to have aesthetic ideas, tastes, and feelings. But precisely which tastes, ideas, and feelings a given person in the society of a given historical period will have cannot be deduced from man's nature; only a materialistic conception of history can give the answer. Actually, this argument is not even a comparison, nor is it a metaphor. It literally falls under the same general law which Plekhanov specifically applied to matters of art. Indeed, the scientific acquisition of knowledge is one type of activity of societal man amongst a number of other activities. Consequently, scientific knowledge acquisition, viewed as the acquisition of knowledge about nature and not as ideology, is a certain type of labor. And as with any labor, it is first of all a process between man and nature, in which man himself confronts nature as a natural force. This process is determined in the first place by the properties of the nature which is being transformed and the properties of the natural force which is transforming, i.e., in the present case, by the nature of the psychological phenomena and the epistemic conditions of man. But precisely because they are natural, i.e., immutable, these properties cannot explain the development, movement, and change in the history of a science. This is generally known. Nevertheless, in each stage of the development of a science we may distinguish, differentiate, or abstract the demands put forward by the very nature of the phenomena under investigation as they are known in the given stage, a stage determined, of course, not by the nature of the phenomena, but by the history of man. Precisely because the natural properties of mental phenomena at a certain level of knowledge are a purely historical category – for the properties change in the process of knowledge acquisition – and because the sum total of known properties is a purely historical quantity, they can be considered as the cause or one of the causes of the historical development of the science.

To illustrate the model for the development of general ideas in psychology just described, we will examine the fate of four ideas which have been influential in the last few decades. In doing so our sole interest will be the fact that made the development of these ideas possible, rather than the ideas in themselves, i.e., a fact rooted in the history of the science, not outside of it. We will not investigate why it is precisely these ideas and their history that is important as a symptom or indication of the stage that the history of the science is going through. At the moment we are interested not in a historical but a methodological question: to what extent are the psychological facts elicited and known at the moment, and what changes in the structure of the science do they require in order to make possible the further acquisition of knowledge on the basis of what is already known? The fate of the four ideas must bear witness to the need of the science at the present moment, to the content and dimensions of this need. The history of the science is important for us insofar as it determines the degree to which psychological facts are cognised.

These four ideas are: psychoanalysis, reflexology, Gestalt psychology, and personalism.

The idea of psychoanalysis sprang from particular discoveries in the area of neuroses. The unconscious determination of a number of mental phenomena and the hidden sexuality of a number of activities and forms, until then not included in the field of erotic phenomena, were established beyond doubt. Gradually this discovery, corroborated by the success of therapeutic measures based on this conception, i.e., sanctioned by practice, was transferred to a number of adjacent areas – the psychopathology of everyday life and child psychology – and it conquered the whole field of the theory of neuroses. In the struggle between the disciplines this idea brought the most remote branches of psychology under its sway. It has been shown that on the basis of this idea a psychology of art and an ethnic psychology can be developed. But psychoanalysis at the same time transcended the boundaries of psychology: sexuality became a metaphysical principle amidst all other metaphysical ideas, psychoanalysis became a world view, psychology a metapsychology. Psychoanalysis has its own theory of knowledge and its own metaphysics, its own sociology and mathematics. Communism and totem, the church and Dostoyevsky's creative work, occultism and advertising, myth and Leonardo da Vinci's inventions – it is all disguised and masked sex and sexuality, and that is all there is to it.
The idea of the conditional reflex followed a similar course. Everybody knows that it originated in
the study of mental salivation in dogs. But then it was extended to a number of other phenomena as
well. It conquered animal psychology. In Bekhterev's system it is applied and used in all domains of
psychology and reigns over them. Everything – sleep, thought, work, and creativity – turns out to be
a reflex. It ended up dominating all psychological disciplines: the collective psychology of art,
industrial psychology and pedology, psychopathology, even subjective psychology. And at the
moment reflexology only rubs shoulders with universal principles, universal laws, first principles of
mechanics. Just as psychoanalysis grew into a metapsychology via biology, reflexology via biology
grows into a world view based on energy. The table of contents of a textbook in reflexology is a
universal catalogue of global laws. And again, just as with psychoanalysis, it turned out that
everything in the world is a reflex. Anna Karenina and kleptomania, the class struggle and a
landscape, language and dream are all reflexes (Bekhterev, 1921; 1923).

Gestalt psychology also originally arose in the concrete psychological investigation of the processes
of form perception. There it received its practical christening; it passed the truth test. But, as it was
born at the same time as psychoanalysis and reflexology, it covered the same path with amazing
uniformity. It conquered animal psychology, and it turned out that the thinking of apes is also a
Gestalt process. It conquered the psychology of art and ethnic psychology, and it turned out that the
primitive conception of the world and the creation of art are Gestalten as well. It conquered child
psychology and psychopathology and both child development and mental disease were covered by
the Gestalt. Finally, having turned into a world view, Gestalt psychology discovered the Gestalt in
physics and chemistry, in physiology and biology, and the Gestalt, withered to a logical formula,
appeared to be the basis of the world. When God created the world he said: let there be Gestalt –
and there was Gestalt everywhere (Kofflka, 1925; Kohler, 1917, 1920; Wertheimer, 1925).

Finally, personalism originally arose in differential psychological research. Being an exceptionally
valuable principle of personality in the theory of psychometrics and in the theory of occupational
choice, etc., it migrated first to psychology in its entirety and then crossed its boundaries. In the
form of critical personalism it extended the concept of personality not only to man, but to animals
and plants as well. One more step, well known to us from the history of psychoanalysis and
reflexology, and everything in the world is personality. The philosophy which began by contrasting
the personality with the thing, by rescuing the personality from the power of things, ended up by
accepting all things as personalities. The things disappeared altogether. A thing is only a part of the
personality: it does not matter whether we are dealing with the leg of a person or the leg of a table.
But as this part again consists of parts etc. and so on to infinity, it – the leg of a person or a table –
again turns out to be a personality in relation to its parts and a part only in relation to the whole. The
solar system and the ant, the tram-driver and Hindenburg, a table and a panther – they are all
personalities (Stern, 1924).

These fates, similar as four drops of the same rain, drag the ideas along one and the same path. The
extension of the concept grows and reaches for infinity and according to the well-known logical
law, its content falls just as impetuously to zero. Each of these four ideas is extremely rich, full of
meaning and sense, full of value and fruitful in its own place. But elevated to the rank of universal
laws they are worthy of each other, they are absolutely equal to each other, like round and empty
zeros. Stern's personality is a complex of reflexes according to Bekhterev, a Gestalt according to
Wertheimer sexuality according to Freud.

And in the fifth stage of development these ideas meet with exactly the same criticism, which can
be reduced to a single formula. To psychoanalysis it is said: the principle of unconscious sexuality is
indispensable for the explanation of hysterical neuroses, but it can explain neither the composition
of the world nor the course of history. To reflexology it is said: we must not make a logical mistake,
the reflex is only one single chapter of psychology, but not psychology as a whole and even less, of
course, the world in its entirety (Vagner, 1923; Vygotsky, 1925a). To Gestalt psychology it is said:
you have found a very valuable principle in your own area. But if thinking consists of no more than
the aspects of unity and the integrated whole, i.e., of no more than the Gestalt formula, and this
same formula expresses the essence of each organic and even physical process, then the picture of the world becomes, of course, amazingly complete and simple – electricity, gravity, and human thinking are reduced to a common denominator. We must not throw both thinking and relation into one single pot of structures: let it first be shown that it belongs in the same pot as structural functions. The new factor guides a broad though limited area. But as a universal principle it does not stand up to critique. Let the thinking of bold theoreticians in their attempts to explain be characterised by the motto “it's all or nothing.” But as a sound counterpoise the cautious investigator should take account of the stubborn opposition of the facts. After all, to try and explain everything means to explain nothing.

Doesn't this tendency of each new idea in psychology to turn into a universal law show that psychology really should rest upon universal laws, that all these ideas wait for a master-idea which comes and puts each different, particular idea in its place and indicates its importance? The regularity of the path covered with amazing constancy by the most diverse ideas testifies, of course, to the fact that this path is predetermined by the objective need for an explanatory principle and it is precisely because such a principle is needed and not available that various special principles occupy its place. Psychology, realising that it is a matter of life or death to find a general explanatory principle, grabs for any idea, albeit an unreliable one.

Spinoza [1677] in his “Treatise on the improvement of the understanding” describes a similar state of knowledge:

A sick man struggling with a deadly disease, when he sees that death will surely be upon him unless a remedy is found, is compelled to seek such a remedy with all his strength, inasmuch as his whole hope lies therein.

Chapter 5

We have traced a distinct tendency towards explanation - which already took shape in the struggle between disciplines for supremacy – in the development of particular discoveries into general principles. But in so doing we already proceeded to the second phase of development of a general science which we have mentioned in passing above. In the first phase, which is determined by the tendency towards generalization, the general science is at bottom quantitatively different from the special ones. In the second phase – the phase in which the tendency towards explanation predominates – the internal structure of the general science is already qualitatively distinct from the special disciplines. Not all sciences, as we will see, go through both phases in their development. The majority knows only a general science in its first phase. The reason for this will become clear as soon as we carefully state the qualitative difference of the second phase.

We have seen that the explanatory principle carries us beyond the boundaries of a given science and must interpret the whole unified area of knowledge as a special category or stage of being amidst a number of other categories, i.e., at stake are highly generalized, ultimate, essentially philosophical principles. In this sense the general science is the philosophy of the special disciplines.

In this sense Binswanger [1922, p. 3] says that a general science such as, for example, general biology elaborates the foundations and problems of a whole area of being. Interestingly, the first book that lay the foundation of general biology was called “The philosophy of zoology” (Lamarck). The further a general investigation penetrates, continues Binswanger, the larger the area it covers, the more abstract and more remote from directly perceived reality the subject matter of such an investigation will become. Instead of living plants, animals, persons, the subject matter of science becomes the manifestations of life and, finally, life itself, just as in physics force and matter replaced bodies and their changes. Sooner or later for each science the moment comes when it must accept itself as a whole, reflect upon its methods and shift the attention from the facts and phenomena to the concepts it utilizes. But from this moment on the general science is distinct from the special one not because it is broader in scope, but because it is organized in a qualitatively
different way. No longer does it study the same objects as the special science; rather, it investigates the concepts of this science. It becomes a critical study in the sense Kant used this expression. No longer being a biological or physical investigation, the critical investigation is concerned with the concepts of biology or physics. Consequently, general psychology is defined by Binswanger as a critical reflection upon the basic concepts of psychology, in short, as “a critique of psychology.” It is a branch of general methodology, i.e., of the part of logic that studies the different applications of logical forms and norms in the various sciences in accordance with the formal and material reality of the nature of their objects, their procedures, and their problems.

This argumentation, based on formal logical premises, is only half true. It is correct that the general science is a theory of ultimate foundations, of the general principles and problems of a given area of knowledge, and that consequently its subject matter, methods of investigation, criteria and tasks are different from those in the special disciplines. But it is incorrect to view it as merely a part of logic, as merely a logical discipline, as if general biology is no longer a biological discipline but a logical one, as if general psychology stops being psychology but becomes logic. It is incorrect to view it as merely critique in the Kantian sense, to assume that it only studies concepts. It is first of all incorrect historically, but also according to the essence of the matter and the inner nature of scientific knowledge.

It is incorrect historically, i.e., it does not correspond with the actual state of affairs in any science. There does not exist a single general science in the form described by Binswanger. Not even general biology in the form in which it actually exists, the biology whose foundations were laid by the works of Lamarck and Darwin, the biology which is until now the canon of genuine knowledge of living matter, is, of course, part of logic, but a natural science, albeit of the highest level. Of course, it does not deal with living, concrete objects such as plants and animals, but with abstractions such as organism, evolution of species, natural selection and life, but in the final analysis it nevertheless studies by means of these abstractions the same reality as zoology and botany. It would be as much a mistake to say that it studies concepts and not the reality reflected in these concepts, as it would to say of an engineer who is studying a blueprint of a machine that he is studying a blueprint and not a machine, or of an anatomist studying an atlas that he studies a drawing and not the human skeleton. For concepts as well are no more than blueprints, snapshots; schemas of reality and in studying them we study models of reality, just as we study a foreign country or city on the plan or geographical map.

When it comes to such well developed sciences as physics and chemistry, Binswanger [1922, p. 4] himself is compelled to admit that a broad field of investigations developed in between the critical and empirical poles and that this area is called theoretical, or general, physics, chemistry, etc. He remarks that natural-scientific theoretical psychology, which in principle wishes to be like physics, acts likewise. However abstractly theoretical physics may formulate its subject of study, for example as “the theory of causal dependencies between natural phenomena,” it nevertheless studies real facts. General physics studies the concept of the physical phenomenon itself, of the physical causal link, but not the various laws and theories on the basis of which the real phenomena may be explained as physically causal. The subject matter of investigation of general physics is rather the physical explanation itself.

As we see, Binswanger himself admits that his conception of the general science diverges in one point from the actual conception as it is realized in a number of sciences. They are not differentiated by a greater or lesser degree of abstraction of the concepts – what can be further from the real, empirical things than causal dependency as the subject matter of a whole science? – but by their ultimate focus: general physics, in the end, focuses on real facts which it wishes to explain by means of abstract concepts. The general science is in principle not focused on real facts, but on the concepts themselves and has nothing to do with the real facts.

Admittedly, when a debate between theory and history arises, when there is a discrepancy between the idea and the fact, as in the present case, the debate is always solved in favor of history or fact.
The argument from the facts may itself not always be appropriate in the area of fundamental research. Then to the reproach that the ideas and facts do not correspond we are fully justified to answer so much the worse for the facts. In the present case, so much the worse for the sciences when they find themselves in a phase of development in which they have not yet attained the stage of a general science. When a general science in this sense does not yet exist, it does not follow that it will never exist, that it should not exist, that we cannot and must not lay its foundations. We must therefore examine the essence, the logical basis of the problem, and then it will also become possible to clarify the meaning of the historical deviation of the general science from its abstract idea.

It is important to make two points.

1. Every natural-scientific concept, however high the degree of its abstraction from the empirical fact, always contains a clot, a sediment of the concrete, real and scientifically known reality, albeit in a very weak solution, i.e., to every ultimate concept, even to the most abstract, corresponds some aspect of reality which the concept represents in an abstract, isolated form. Even purely fictitious, not natural-scientific but mathematical concepts ultimately contain some echo, some reflection of the real relations between things and the real processes, although they did not develop from empirical, actual knowledge, but purely a priori, via the deductive path of speculative logical operations. As Engels demonstrated, even such an abstract concept as the series of numbers, or even such an obvious fiction as zero, i.e., the idea of the absence of any magnitude, is full of properties that are qualitative, i.e., in the end they correspond in a very remote and dissolved form to real, actual relations. Reality exists even in the imaginary abstractions of mathematics.

16 is not only the addition of 16 unities, it is also the square of 4 and the biquadrate of 2. ... Only even numbers can be divided by two ... For division by 3 we have the rule of the sum of the figures. ... For 7 there is a special law. ... Zero destroys any other number by which it is multiplied; when it is made divisor or dividend with regard to some other number, this number will in the first case become infinitely large, in the second case infinitely small [Engels, 1925/1978, pp. 522/524].

About both concepts of mathematics one might say what Engels, in the words of Hegel, says about zero: “The non-existence of something is a specific non-existence” [ibid., p. 525], i.e., in the end it is a real non-existence. But maybe these qualities, properties, the specificity of concepts as such, have no relation whatsoever to reality.

Engels [ibid., p. 530] clearly rejects the view that in mathematics we are dealing with purely free creations and imaginations of the human mind to which nothing in the objective world corresponds. Just the opposite is the case. We meet the prototypes of each of these imaginary quantities in nature. The molecule possesses exactly the same properties in relation to its corresponding mass as the mathematical differential in relation to its variable.

Nature operates with these differentials, the molecules, in exactly the same way and according to the same laws as mathematics with its abstract differentials [ibid., p. 531].

In mathematics we forget all these analogies and that is why its abstractions turn into something enigmatic. We can always find

the real relations from which the mathematical relation ... was taken ... and even the natural analogues of the mathematical way to make these relations manifest [ibid., p. 534]

The prototypes of mathematical infinity and other concepts lie in the real world

The mathematical infinite is taken, albeit unconsciously, from reality, and that is why it can only be explained on the basis of reality, and not on the basis of itself, the mathematical abstraction (ibid., p. 534)

If this is true with respect to the highest possible, i.e., mathematical abstraction, then how much more obvious it is for the abstractions of the real natural sciences. They must, of course, be explained only on the basis of the reality from which the system and not on the basis of themselves,
the abstraction.

2. The second point that we need to make in order to present a fundamental analysis of the problem of the general science is the opposite of the first. Whereas the first claimed that the highest scientific abstraction contains an element of reality, the second is the opposite theorem: even the most immediate, empirical, raw, singular natural scientific fact already contains a first abstraction. The real and the scientific fact are distinct in that the scientific fact is a real fact included into a certain system of knowledge, i.e., an abstraction of several features from the inexhaustible sum of features of the natural fact. The material of science is not raw, but logically elaborated, natural material which has been selected according to a certain feature. Physical body, movement, matter – these are all abstractions. The fact itself of naming a fact by a word means to frame this fact in a concept, to single out one of its aspects; it is an act toward understanding this fact by including it into a category of phenomena which have been empirically studied before. Each word already is a theory, as linguists have noted for quite some time and as Potebnya [1913/1993] has brilliantly demonstrated.

Everything described as a fact is already a theory. These are the words of Goethe to which Munsterberg refers in arguing the need for a methodology. When we meet what is called a cow and say: “This is a cow,” we add the act of thinking to the act of perception, bringing the given perception under a general concept. A child who first calls things by their names is making genuine discoveries. I do not see that this is a cow, for this cannot be seen. I see something big, black, moving, plowing, etc., and understand that this is a cow. And this act is an act of classification, of assigning a singular phenomenon to the class of similar phenomena, of systematizing the experience, etc. Thus, language itself contains the basis and possibilities for the scientific knowledge of a fact. The word is the germ of science and in this sense we can say that in the beginning of science was the word.

Who has seen, who has perceived such empirical facts as the heat itself in steam-generation? It cannot be perceived in a single real process, but we can infer this fact with confidence and to infer means to operate with concepts.

In Engels we find a good example of the presence of abstractions and the participation of thought in every scientific fact. Ants have other eyes than we have. They see chemical beams that are invisible to us. This is a fact. How was it established? How can we know that “ants see things that are invisible to us”? Naturally, this is based on the perceptions of our eye, but in addition to that we have not only the other senses but the activity of our thinking as well. Thus, establishing a scientific fact is already a matter of thinking, that is, of concepts.

To be sure, we will never know how these chemical beams look to the ants. Who deprecates this is beyond help [Engels, 1925/1978, p. 507].

This is the best example of the non-coincidence of the real and the scientific fact. Here this non-coincidence is presented in an especially vivid way, but it exists to a certain degree in each fact. We never saw these chemical beams and did not perceive the sensations of ants, i.e., that ants see certain chemical beams is not a real fact of immediate experience for us, but for the collective experience of mankind it is a scientific fact. But what to say, then, about the fact that the earth turns around the sun? For here in the thinking of man the real fact, in order to become a scientific fact, had to turn into its opposite, although the earth’s rotation around the sun was established by observations of the sun’s rotations around the earth.

By now we are equipped with all we need to solve this problem and we can go straight for the goal. If at the root of every scientific concept lies a fact and, vice versa, at the basis of every scientific fact lies a concept, then from this it inevitably follows that the difference between general and empirical sciences as regards the object of investigation is purely quantitative and not fundamental. It is a difference of degree and not a difference of the nature of the phenomenon. The general sciences do not deal with real objects, but with abstractions. They do not study plants and animals,
but life. Their subject matter is scientific concepts. But life as well is part of reality and these concepts have their prototypes in reality. The special sciences have the actual facts of reality as their subject matter, they do not study life as such, but actual classes and groups of plants and animals. But both the plant and the animal, and even the birch tree and the tiger, and even this birch tree and this tiger are already concepts. And scientific facts as well, even the most primitive ones, are already concepts. Fact and concept form the subject matter of all disciplines, but to a different degree, in different proportion. Consequently, general physics does not cease being a physical discipline and does not become part of logic because it deals with the most abstract physical concepts. Ultimately, even these serve to know some part of reality.

But perhaps the nature of the objects of the general and the special disciplines is really the same, maybe they differ only in the proportion of concept and fact, and the fundamental difference which allows us to count the one as logic and the other as physics lies in the direction, the goal, the point of view of both investigations, so to speak, in the different role played by the same elements in both cases?

Could we perhaps put it like this: both concept and fact participate in the development of the subject matter of any science, but in one case – the case of empirical science – we utilize concepts to acquire knowledge about facts, and in the second – general science – we utilize facts to acquire knowledge about concepts? In the first case the concepts are not the subject matter, the goal, the objective of knowledge, but its tools, means, auxiliary devices. The goal, the subject matter of knowledge are the facts. As a result of the growth of knowledge the number of known facts is enhanced, but not the number of concepts. Like any tool of labor the concepts, in contrast, suffer wear and tear in their use, become worn down, in need of revision and often of replacement. In the second case it is the other way around; we study the concepts themselves as such, their correspondence with the facts is only a means, a way, a method, a verification of their suitability. As a result we do not learn of new facts, but acquire either new concepts or new knowledge about the concepts. After all, we can look twice at a drop of water under the microscope and this will be two completely distinct processes, although both the drop and the microscope will be the same both times: the first time we study the composition of the drop of water by means of the microscope; the second time we verify the suitability of the microscope itself by looking at a drop of water – isn’t it like that?

But the whole difficulty of the problem is exactly that it is not like that. It is true that in a special science we utilize concepts as tools to acquire knowledge of facts. But using tools means at the same time to test them, to study and master them, to throw away the ones that are unfit, to improve them, to create new ones. Already in the very first stage of the scientific processing of empirical material the use of a concept is a critique of the concept by the facts, the comparison of concepts, their modification. Let us take as an example the two scientific facts mentioned above, which definitely do not belong to general science: the earth’s rotation around the sun and the vision of ants. How much critical work on our perceptions and, thus, on the concepts linked with them, how much direct study of these concepts – visibility, invisibility, apparent movement – how much creation of new concepts, of new links between concepts, how much modification of the very concepts of vision, light, movement etc. was needed to establish these facts! And, finally, does not the very selection of the concepts needed to know these facts require an analysis of the concepts in addition to the analysis of the facts? After all, if concepts, as tools, were set aside for particular facts of experience in advance, all science would be superfluous: then a thousand administrator-registrators or statistician-counters could note down the universe on cards, graphs, columns. Scientific knowledge differs from the registration of a fact in that it selects the concept needed, i.e., it analyzes both fact and concept.

Any word is a theory. To name an object is to apply a concept to it. Admittedly, by means of the word we wish to comprehend the object. But each name, each application of the word, this embryo of science, is a critique of the word, a blurring of its form, an extension of its meaning. Linguists have clearly enough demonstrated how words change from being used. After all, language
otherwise would never be renewed, words would not die, be born, or become obsolete.

Finally, each discovery in science, each step forward in empirical science is always at the same time an act of criticizing the concept. Pavlov discovered the fact of conditional reflexes. But didn’t he really create a new concept! at the same time? Did we really call a trained, well-learned movement a reflex before? And it cannot be otherwise: if science would only discover facts without extending the boundaries of its concepts, it would not discover anything new. It would make no headway in finding more and more new specimens of the same concepts. Each tiny new fact is already an extension of the concept. Each newly discovered relation between two facts immediately requires a critique of the two corresponding concepts and the establishment of a new relation between them. The conditional reflex is a discovery of a new fact by means of an old concept. We learned that mental salivation develops directly from the reflex, more correctly, that it is the same reflex, but operating under other conditions. But at the same time it is a discovery of a new concept by means of an old fact: by means of the fact “salivation occurs at the sight of food,” which is well known to all of us, we acquired a completely new concept of the reflex, our idea of it diametrically changed. Whereas before, the reflex was a synonym for a premental, unconscious, immutable fact, nowadays the whole mind is reduced to reflexes, the reflex has turned out to be a most flexible mechanism, etc. How would this have been possible if Pavlov had only studied the fact of salivation and not the concept of the reflex? This is essentially the same thing expressed in two ways, for in each scientific discovery knowledge of the fact is to the same extent knowledge of the concept. The scientific investigation of facts differs from registration in that it is the accumulation of concepts, the circulation of concepts and facts with a conceptual return.

Finally, the special sciences create all the concepts that the general science studies. For the natural sciences do not spring from logic, it is not logic that provides them with ready-made concepts. Can we really assume that the creation of ever more abstract concepts proceeds completely unconsciously? How can theories, laws, conflicting hypotheses exist without the critique of concepts? How can we create a theory or advance a hypothesis, i.e., something which transcends the boundaries of the facts, without working on the concepts?

But perhaps the study of concepts in the special sciences proceeds in passing, accidentally as the facts are being studied, whereas the general science studies only concepts? This would not be correct either. We have seen that the abstract concepts with which the general science operates possess a kernel of reality. The question arises what science does with this kernel – is it ignored, forgotten, covered in the inaccessible stronghold of abstractions like pure mathematics? Does one never in the process of investigation, nor after it, turn to this kernel, as if it did not exist at all? One only has to examine the method of investigation in the general science and its ultimate result to see that this is not true. Are concepts really studied by pure deduction, by finding logical relations between concepts, and not by new induction, by new analysis, the establishing of new relations, in a word – by work on the real contents of these concepts? After all, we do not develop our ideas from specific premises, as in mathematics, but we proceed by induction – we generalize enormous groups of facts, compare them, analyze and create new abstractions. This is the way general biology and general physics proceed. And not a single general science can proceed otherwise, since the logical formula “A is B” has been replaced by a definition, i.e., by the real A and B: by mass, movement, body, and organism. And the result of an investigation in a general science is not new forms of inter-relations of concepts, as in logic, but new facts: we learn of evolution, heredity, inertia. How do we learn of this, how do we reach the concept of evolution? We compare such facts as the data of comparative anatomy and physiology, botany and zoology, embryology and photo and zootechnics etc., i.e., we proceed as we proceed with the individual facts in a special science. And on the basis of a new study of the facts elaborated by the various sciences we establish new facts, i.e., in the process of investigation and in its result we are constantly operating with facts.

Thus, the difference between the general and the special science as concerns their goal, orientation, and the elaboration of concepts and facts, again appears to be only quantitative. It is a difference of degree of one and the same phenomenon and not of the nature of two sciences. It is not absolute or
Finally, let us proceed to a positive definition of the general science. It might seem that if the difference between general and special science as to their subject matter, method, and goal of study is merely relative and not absolute, quantitative and not fundamental, we lose any ground to distinguish them theoretically. It might seem that there is no general science at all as distinct from the special sciences. But this is not true, of course. Quantity turns into quality here and provides the basis for a qualitatively distinct science. However the latter is not torn away from the given family of sciences and transferred to logic. The fact that at the root of every scientific concept lies a fact does not mean that the fact is represented in every scientific concept in the same way. In the mathematical concept of infinity reality is represented in a way completely different from the way it is represented in the concept of the conditional reflex. In the concepts of a higher order with which the general science is dealing, reality is represented in another way than in the concepts of an empirical science. And the way, character, and form in which reality is represented in the various sciences in every case determines the structure of every discipline.

But this difference in the way of representing reality, i.e., in the structure of the concepts, should not be understood as something absolute either. There are many transitional levels between an empirical science and a general one. Binswanger [1922, p. 4] says that not a single science that deserves the name can “leave it at the simple accumulation of concepts, it strives rather to systematically develop concepts into rules, rules into laws, laws into theories.” The elaboration of concepts, methods, and theories takes place within the science itself during the whole course of scientific knowledge acquisition, i.e., the transition from one pole to the other, from fact to concept, is accomplished without pausing for a single minute. And thereby the logical abyss, the impassable line between general and special science is erased, whereas the factual independence and necessity of a general science is created. Just like the special science itself internally takes care of all the work of funnelling facts via rules into laws and laws via theories into hypotheses, general science carries out the same work, by the same method, with the same goals, but for a number of the various special sciences.

This is entirely similar to Spinoza’s argumentation about method. A theory of method is, of course, the production of means of production, to take a comparison from the field of industry. But in industry the production of means of production is no special, primordial production, but forms part of the general process of production and itself depends upon the same methods and tools of production as all other production.

Spinoza [1677/1955, pp. 11-12] argues that

we must first take care not to commit ourselves to a search going back to infinity, that is, in order to discover the best method for finding the truth, there is no need of another method to discover such method; nor of a third method for discovering the second, and so on to infinity. By such proceedings, we should never arrive at the knowledge of the truth, or, indeed, at any knowledge at all. The matter stands on the same footing as the making of material tools, which might be argued about in a similar way. For, in order to work iron, a hammer is needed, and the hammer cannot be forthcoming unless it has been made; but in order to make it, there was need of another hammer and other tools, and so on to infinity. We might thus vainly endeavor to prove that men have no power of working iron. But as men at first made use of the instruments supplied by nature to accomplish very easy pieces of workmanship, laboriously and imperfectly, and then, when these were finished, wrought other things more difficult with less labor and greater perfection; and so gradually mounted from the simplest operations to the making of tools, and from the making of tools to the making of more complex tools, and fresh feats of workmanship, till they arrived at making, with small expenditure of labor, the vast number of complicated mechanisms which they now possess. So, in like manner, the intellect, by its native strength, makes for itself intellectual instruments, whereby it acquires strength for performing other intellectual operations, and from these operations gets again fresh instruments, or the power of pushing its investigations further,
and thus gradually proceeds till it reaches the summit of wisdom.

The methodological current to which Binswanger belongs also admits that the production of tools and that of creative work are, in principle, not two separate processes in science, but two sides of the same process which go hand in hand. Following Rickert, he defines each science as the processing \([\text{Bearbeitung}]\) of material, and therefore for him two problems arise in every science – one with respect to the material and the other concerning its processing. One cannot, however, draw such a sharp dividing line, since the concept of the object of the empirical science already contains a good deal of processing. And he (Binswanger, 1922, pp. 7-8) distinguishes between the raw material, the real object \([\text{wirklichen Gegenstand}]\) and the scientific object \([\text{wissenschaftlichen Gegenstand}]\). The latter is created by science from the real object via concepts. When we raise a third cluster of problems – about the relation between the material and its processing, i.e., between the object and the method of science – the debate must again focus on what is determined by what: the object by the method, or vice versa. Some, like Stumpf, suppose that all differences in method are rooted in differences between the objects. Others, like Rickert, are of the opinion that various objects, both physical and mental, require one and the same method. But, as we see, we do not find grounds for a demarcation of the general from the special science here either.

All this only indicates that we can give no absolute definition of the concept of a general science and that it can only be defined relative to the special science. From the latter it is distinguished not by its object, nor by the method, goal, or result of the investigation. But for a number of special sciences which study related realms of reality from a single viewpoint it accomplishes the same work and by the same method and with the same goal as each of these sciences accomplish for their own material. We have seen that no science confines itself to the simple accumulation of material, but rather that it subjects this material to diverse and prolonged processing, that it groups and generalizes the material, creates a theory and hypotheses which help to get a wider perspective on reality than the one which follows from the various uncoordinated facts. The general science continues the work of the special sciences. When the material is carried to the highest degree of generalization possible in that science, further generalization is possible only beyond the boundaries of the given science and by comparing it with the material of a number of adjacent sciences. This is what the general science does. Its single difference from the special sciences is that it carries out its work with respect to a number of sciences. If it carried out the same work with respect to a single science it would never come to the fore as an independent science, but would remain a part of that single science. The general science can therefore be defined as a science that receives its material from a number of special sciences and carries out the further processing and generalization of the material which is impossible within each of the various disciplines.

The general science therefore stands to the special one as the theory of this special science to the number of its special laws, i.e., according to the degree of generalization of the phenomena studied. The general science develops out of the need to continue the work of the special sciences where these end. The general science stands to the theories, laws, hypotheses and methods of the special sciences as the special science stands to the facts of the reality it studies. Biology receives material from various sciences and processes it in the way each special science does with its own material. The whole difference is that [general] biology begins where embryology, zoology, anatomy etc. stop, that it unites the material of the various sciences, just as a [special] science unites various materials within its own field.

This viewpoint can fully explain both the logical structure of the general science and the factual, historical role of the general science. If we accept the opposite opinion that the general science is part of logic, it becomes completely inexplicable why it is the highly developed sciences, which already managed to create and elaborate very refined methods, basic concepts and theories, which produce a general science. It would seem that new, young, beginning disciplines are more in need of borrowing concepts and methods from another science. Secondly, why does only a group of adjacent disciplines lead to a general science and not each science on its own – why do botany, zoology and anthropology lead to biology? Couldn’t we create a logic of just zoology and just
botany, like the logic of algebra? And indeed such separate disciplines can exist and do exist, but this does not make them general sciences, just as the methodology of botany does not become biology.

Like the whole current, Binswanger proceeds from an idealistic conception of scientific knowledge, i.e., from idealistic epistemic premises and a formal logical construction of the system of sciences. For Binswanger, concepts and real objects are separated by an unbridgeable gap. Knowledge has its own laws, its own nature, its a priori, which it projects unto the reality that is known. That is why for Binswanger these a priori, these laws, this knowledge, can be studied separately, in isolation from what is cognized by them. For him a critique of scientific reason in biology, psychology, and physics is possible, just like the critique of pure reason was possible for Kant. Binswanger is prepared to admit that the method of knowing determines reality, just as in Kant reason dictated the laws of nature. For him the relations between sciences are not determined by the historical development of these sciences and not even by the demands of scientific experience, i.e., in the final analysis they are not determined by the demands of the reality studied by this science, but by the formal logical structure of the concepts.

In another philosophical system such a conception would be unthinkable, i.e., when we reject these epistemological and formal logical premises, the whole conception of the general science falls immediately. As soon as we accept the realistic, objective, i.e., the materialistic viewpoint in epistemology and the dialectical viewpoint in logic and in the theory of scientific knowledge, such a theory becomes impossible. With that new viewpoint we must immediately accept that reality determines our experience, the object of science and its method and that it is entirely impossible to study the concepts of any science independent of the realities it represents.

Engels [1925/1978, p. 514] has pointed out many times that for dialectical logic the methodology of science is a reflection of the methodology of reality. He says that

*The classification of sciences of which each analyzes a different form of movement, or a number of movements that are connected and merge into each other, is at the same time a classification, an ordering according to the inherent order of these forms of movement themselves and in this resides their importance.*

Can it be said more clearly? In classifying the sciences we establish the hierarchy of reality itself

*The so-called objective dialectic reigns in all nature, and the so-called subjective dialectic, dialectical thinking, is only a reflection of the movement by opposition, that reigns in all nature* [ibid., p. 481].

Here the demand to take account of the objective dialectic in studying the subjective dialectic, i.e., dialectical thinking in some science, is clearly expressed. Of course, by no means does this imply that we close our eyes to the subjective conditions of this thinking. The same Engels who established a correspondence between being and thinking in mathematics says that “all laws of number are dependent upon and determined by the system that is used. In the binary and ternary system 2 x 2 does not = 4, but = 100 or = 11” [ibid., p. 523]. Extending this, we might say that subjective assumptions which follow from knowledge will always influence the way of expressing the laws of nature and the relation between the different concepts. We must take them into account, but always as a reflection of the objective dialectic.

We must, therefore, contrast epistemological critique and formal logic as the foundations of a general science with a dialectic “which is conceived of as the science of the most general laws of all movement. This implies that its laws must be valid for both movement in nature and human history and movement in thinking”[ibid., p. 530]. This means that the dialectic of psychology – this is what we may now call the general psychology in opposition to Binswanger’s definition of a “critique of psychology” – is the science of the most general forms of movement (in the form of behavior and knowledge of this movement), i.e., the dialectic of psychology is at the same time the dialectic of man as the object of psychology, just as the dialectic of the natural sciences is at the same time the
dialectic of nature.

Engels does not even consider the purely logical classification of judgments in Hegel to be based merely on thinking, but on the laws of nature. This he regards as a distinguishing characteristic of dialectical logic.

What in Hegel seems a development of the judgment as a category of thinking as such, now appears to be a development of our knowledge of the nature of movement based on empirical grounds. And this proves that the laws of thinking and the laws of nature correspond necessarily with each other as soon as they are known properly [ibid., p. 493]

The key to general psychology as a part of dialectics lies in these words: this correspondence between thinking and being in science is at the same time object, highest criterion, and even method, i.e., general principle of the general psychology.

Chapter 6

General psychology stands to the special disciplines as algebra to arithmetic. Arithmetic operates with specific, concrete quantities; algebra studies all kinds of general forms of relations between qualities. Every arithmetical operation can, consequently, be considered as a special case of an algebraic formula. From this it obviously follows that for each special discipline and for each of its laws the question as to which general formula they form a special case of is not at all indifferent. The general science’s fundamentally guiding and supreme role, so to speak, does not follow from the fact that it stands above the sciences, it does not come from above, from logic, i.e., from the ultimate foundations of scientific knowledge, but from below, from the sciences themselves which delegate the authorization of truth to the general science. The general science, consequently, develops from the special position it occupies with regard to the special ones: it integrates their sovereign ties, forms their representative. If we graphically represent the system of knowledge which covers all psychological disciplines as a circle, general science will correspond to the center of the circumference.

Now let us suppose that we have various centers as in the case of a debate between separate disciplines that aspire to become the center, or in the case of different ideas claiming to be the central explanatory principle. It is obvious that to these will correspond different circumferences and each new center will at the same time be a peripheral point on the former circumference. Consequently, we get several circumferences that intersect with each other. In our example this new position of each circumference graphically represents the special area of knowledge that is covered by psychology depending on the center, i.e., the general discipline.

Whoever takes the viewpoint of the general discipline, i.e., deals with the facts of the special disciplines not on a footing of equality, but as the material of a science, just as these disciplines themselves deals with the facts of reality, will immediately change the viewpoint of critique for the viewpoint of investigation. Criticism is on the same level as what is being criticized; it proceeds fully within the given discipline; its goal is exclusively critical and not positive; it wishes to know only whether and to what extent some theory is correct; it evaluates and judges, but does not investigate. A criticizes B, but both occupy the same position as to the facts. Things change when A begins to deal with B as B does with the facts, i.e., when he does not criticize B, but investigates him. The investigation already belongs to general science, its tasks are not critical, but positive. It does not wish to evaluate some theory, but to learn something new about the facts themselves which are represented in the theory. While science uses critique as a means, the course [of the investigation, Russian eds.] and the result of this process nevertheless differ fundamentally from a critical examination. Critique, in the final analysis, formulates an opinion about an opinion, albeit a very solid and well-founded opinion. A general investigation establishes, ultimately, objective laws and facts.
Only he who elevates his analysis from the level of the critical discussion of some system of views to the level of a fundamental investigation by means of the general science will understand the objective meaning of the crisis that is taking place in psychology. He will see the lawfulness of the clash of ideas and opinions that is taking place, which is determined by the development of the science itself and by the nature of the reality it studies at a given level of knowledge. Instead of a chaos of heterogeneous opinions, a motley discordance of subjective utterances, he will see an orderly blueprint of the fundamental opinions concerning the development of the science, a system of the objective tendencies which are inherent in the historical tasks brought forward by the development of the science and which act behind the backs of the various investigators and theorists with the force of a steel spring. Instead of critically discussing and evaluating some author, instead of establishing that this author is guilty of inconsistency and contradictions, he will devote a positive investigation to the question what the objective tendencies in science require. And as a result, instead of opinions about an opinion he will get an outline of the skeleton of the general science as a system of defining laws, principles and facts.

Only such an investigator realizes the real and correct meaning of the catastrophe that is taking place and has a clear idea of the role, place, and meaning of each different theory or school. Rather than by the impressionism and subjectivism inevitable in each criticism, he will be led by scientific reliability and veracity. For him (and this will be the first result of the new viewpoint) the individual differences will vanish—he will understand the role of personality in history. He will understand that to explain reflexology’s claims to be a universal science from the personal mistakes, opinions, particularities, and ignorance of its founders is as impossible as to explain the French revolution from the corruption of the king or court. He will see what and how much in the development of science depends upon the good and bad intention of its practitioners, what can be explained from their intentions and what from this intention itself should, on the contrary, be explained on the basis of the objective tendencies operative behind the backs of these practitioners. Of course, the particularities of his personal creativity and the entire weight of his scientific experience determined the specific form of universalism which the idea of reflexology acquired in the hands of Bekhterev. But in Pavlov [1928/1963, p. 41] as well, whose personal contribution and scientific experience are entirely different, reflexology is the “ultimate science,” “an omnipotent method,” which brings “full, true and permanent human happiness.” And in their own way behaviorism and Gestalt theory cover the same route. Obviously, rather than the mosaic of good and evil intentions among the investigators we should study the unity in the processes of regeneration of scientific tissue in psychology, which determines the intention of all the investigators.

Chapter 7

Precisely what the dependency of each psychological operation upon the general formula means can be illustrated with any problem that transcends the boundaries of the special discipline that raised it.

When Lipps [1897, p. 146] says about the unconscious that it is less a psychological problem than the problem for psychology, he has in mind that the unconscious is a problem of general psychology. By this he wished to say, of course, no more than that this question will be answered not as a result of this or that particular investigation, but as a result of a fundamental investigation by means of the general science, i.e., by comparing the widely varying data of the most heterogeneous areas of science; by correlating the given problem with several of the basic premises of scientific knowledge, on the one hand, and with several of the most general results of all sciences, on the other; by finding a place for this concept in the system of the basic concepts of psychology; by a fundamental dialectical analysis of the nature of this concept and the features of being that it corresponds to and reflects. This investigation logically precedes any concrete investigation of particular questions of subconscious life and determines the very formulation of the problem in such investigations.

As Munsterberg [1920, p. v], defending the need for such an investigation for another set of
problems, splendidly put it: “In the end it is better to get an approximately exact preliminary answer to a question that is stated correctly than to answer with a precision to the last decimal point a question that is stated inaccurately.” A correct statement of a question is no less a matter of scientific creativity and investigation than a correct answer – and it is much more crucial. The vast majority of contemporary psychological investigations write out the last decimal point with great care and precision in answer to a question that is stated fundamentally incorrectly.

Whether we accept with Munsterberg [1920, pp. 158-163] that the subconscious is simply physiological and not psychological; or whether we agree with others that the subconscious consists of phenomena that temporarily are absent from consciousness, like the whole mass of potentially conscious reminiscences, knowledge and habits; whether we call those phenomena subconscious that do not reach the threshold of consciousness, or those of which we are minimally conscious, which are peripheral in the field of consciousness, automatic and unnoted; whether we find a suppression of the sexual drive to be the basis of the subconscious, like Freud, or our second ego, a special personality; finally, whether we call these phenomena un-, sub-, or superconscious, or like Stern accept all of these terms – it all fundamentally changes the character, quantity, composition, nature, and properties of the material which we will study. The question partially predetermines the answer.

It is this feeling of a system, the sense of a [common] style, the understanding that each particular statement is linked with and dependent upon the central idea of the whole system of which it forms a part, which is absent in the essentially eclectic attempts at combining the parts of two or more systems that are heterogeneous and diverse in scientific origin and composition. Such are, for instance, the synthesis of behaviorism and Freudian theory in the American literature; Freudian theory without Freud in the systems of Adler and Jung; the reflexological Freudian theory of Bekhterev and Zalkind; finally, the attempts to combine Freudian theory and Marxism (Luria, 1925; Fridman, 1925). So many examples from the area of the problem of the subconscious alone! In all these attempts the tail of one system is taken and placed against the head of another and the space between them is filled with the trunk of a third. It isn’t that they are incorrect, these monstrous combinations, they are correct to the last decimal point, but the question they wish to answer is stated incorrectly. We can multiply the number of citizens of Paraguay with the number of kilometers from the earth to the sun and divide the product by the average life span of the elephant and carry out the whole operation irreproachably, without a mistake in any number, and nevertheless the final outcome might mislead someone who is interested in the national income of this country. What the eclectics do, is to reply to a question raised by Marxist philosophy with an answer prompted by Freudian metapsychology.

In order to show the methodological illegitimacy of such attempts, we will first dwell upon three types of combining incompatible questions and answers, without thinking for one moment that these three types exhaust the variety of such attempts.

The first way in which any school assimilates the scientific products of another area consists of the direct transposition of all laws, facts, theories, ideas etc., the usurpation of a more or less broad area occupied by other investigators, the annexation of foreign territory. Such a politics of direct usurpation is common for each new scientific system which spreads its influence to adjacent disciplines and lays claim to the leading role of a general science. Its own material is insufficient and after just a little critical work such a system absorbs foreign bodies, submits them, filling the emptiness of its inflated boundaries. Usually one gets a conglomerate of scientific theories, facts, etc. which have been squeezed into the framework of the unifying idea with horrible arbitrariness.

Such is the system of Bekhterev’s reflexology. He can use anything: even Vvedensky’s theory about the unknowability of the external ego, i.e., an extreme expression of solipsism and idealism in psychology, provided that this theory clearly confirms his particular claim about the need for an objective method. That it breaches the general sense of the whole system, that it undermines the foundations of the realistic approach to personality does not matter to this author (we observe that
Vvedensky, too, fortifies himself and his theory with a reference to the work of Pavlov, without understanding that by turning for help to a system of objective psychology he extends a hand to his grave-digger. But for the methodologist it is highly significant that such antipodes as Vvedensky-Pavlov and Bekhterev-Vvedensky do not merely contradict each other, but necessarily presuppose each other’s existence and view the coincidence of theft conclusions as evidence for “the reliability of these conclusions.” For this third person [the methodologist, Russian eds.] it is clear that we are not dealing here with a coincidence of conclusions which were reached fully independently by representatives of different specialties, for example the philosopher Vvedensky and the physiologist Pavlov, but with a coincidence of the basic assumptions, starting points and philosophical premises of dualistic idealism. This “coincidence” is presupposed from the very start: Bekhterev presupposes Vvedensky – when the one is right, the other is right as well.

Einstein’s principle of relativity and the principles of Newtonian mechanics, incompatible in themselves, get on perfectly well in this eclectic system. In Bekhterev’s “Collective reflexology” he absolutely gathered a catalogue of universal laws. Characteristic of the methodology of the system is the way imagination is given free reign, the fundamental inertia of the idea which by direct communication, omitting all intermediate steps, leads us from the law of the proportional correlation of the speed of movement with the moving force, established in mechanics, to the fact of the USA’s involvement in the great European war, and back again – from the experiment of a certain Dr. Schwarzmann on the frequency limits of electrocutaneous irritation leading to an association reflex to the “universal law of relativity which obtains everywhere and which, as a result of Einstein’s brilliant investigations, has been finally demonstrated in regard to heavenly bodies.”

Needless to say, the annexation of psychological areas is carried out no less categorically and no less boldly. The investigations of the higher thought processes by the Wurzburg school, like the results of the investigations of other representatives of subjective psychology, “may be harmonized with the scheme of cerebral or association reflexes.” Never mind that this very phrase strikes out all the fundamental premises of his own system: for if we can harmonize everything with the reflex schema and everything “is in perfect accord” with reflexology – even what has been discovered by subjective psychology – why take up arms against it? The discoveries made in Wurzburg were made with a method which, according to Bekhterev, cannot lead to the truth. However, they are in complete harmony with the objective truth. How is that?

The territory of psychoanalysis is annexed just as carelessly. For this it suffices to declare that “in Jung’s doctrine of complexes we find complete agreement with the data of reflexology.” But one passage higher it was said that this doctrine was based on subjective analysis, which Bekhterev rejects. No problem: we live in the world of pre-established harmony, of the miraculous correspondence, of the amazing coincidence of theories based on false analyses and the data of the exact sciences. To be more precise, we live in the world – according to Blonsky (1925a, p. 226) – of “terminological revolutions.”

Our whole eclectic epoch is filled with such coincidences. Zalkind, for example, annexes the same areas of psychoanalysis and the theory of complexes in the name of the dominant. It turns out that the psychoanalytic school developed the same concepts about the dominant completely independently from the reflexological school, but “in our terms and by another method.” The “complex orientation” of the psychoanalysts, the “strategical set” of the Adlerians, these are dominants as well, not in general physiological but clinical, general therapeutic formulations. The annexation – the mechanical transposition of bits of a foreign system into one’s own – in this case, as always, seems almost miraculous and testifies to its truth. Such an “almost miraculous” theoretical and factual coincidence of two doctrines, which work with totally different material and by entirely different methods, forms a convincing confirmation of the correctness of the principal path that contemporary reflexology is following. We remember that Vvedensky too saw in his coincidence with Pavlov a testimony of the truth of his statements. And more: this coincidence testifies, as Bekhterev more than once showed, to the fact that we may arrive at the same truth by entirely different methods. Actually, this coincidence testifies only to the methodological
unscrupulousness and eclecticism of the system within which such a coincidence is observed. “He that toucheth pitch shall be defiled,” as the saying goes. He who borrows from the psychoanalysts – Jung’s doctrine of complexes, Freud’s catharsis, Adler’s strategical set – gets his share of the “pitch” of these systems, i.e., the philosophical spirit of the authors.

Whereas the first method of transposition of foreign ideas from one school into another resembles the annexation of foreign territory, the second method of comparing foreign ideas is similar to a treaty between two allied countries in which both retain their independence, but agree to act together proceeding from their common interests. This method is usually applied in the merger of Marxism and Freudian theory. In so doing the author uses a method that by analogy with geometry might be called the method of the logical superposition of concepts. The system of Marxism is defined as being monistic, materialistic, dialectic etc. Then the monism, materialism etc. of Freud’s system is established; the superimposed concepts coincide and the systems are declared to have fused. Very flagrant, sharp contradictions which strike the eye are removed in a very elementary way: they are simply excluded from the system, are declared to be exaggerations, etc. Thus, Freudian theory is de-sexualized as pansexualism obviously does not square with Marx’s philosophy. No problem, we are told – we will accept Freudian theory without the doctrine of sexuality. But this doctrine forms the very nerve, soul, center of the whole system. Can we accept a system without its center? After all, Freudian theory without the doctrine of the sexual nature of the unconscious is like Christianity without Christ or Buddhism with Allah.

It would be a historical miracle, of course, if a full-grown system of Marxist psychology were to originate and develop in the West, from completely different roots and in a totally different cultural situation. That would imply that philosophy does not at all determine the development of science. As we can see, they started from Schopenhauer and created a Marxist psychology! But this would imply the total fruitlessness of the attempt itself to merge Freudian theory with Marxism, just as the success of Bekhterev’s coincidence would imply the bankruptcy of the objective method: after all, if the data of subjective analysis fully coincide with the data of objective analysis, one may ask in what sense subjective analysis is inferior. If Freud, without knowing it himself, thinking about other philosophical systems and consciously siding with them, nevertheless created a Marxist doctrine of the mind, then in the name of what, may one ask, is it necessary to disturb this most fruitful delusion: after all, according to these authors, we need not change anything in Freud. Why, then, merge psychoanalysis with Marxism? In addition, the following interesting question arises: how is it possible that this system which entirely coincides with Marxism logically led to making the idea of sexuality, which is obviously irreconcilable with Marxism, into its cornerstone? Is not the method to a large extent responsible for the conclusions arrived at with its help? And bow could a true method which creates a true system, based on true premises, lead its authors to a false theory, to a false central idea? One has to dispose of a good deal of methodological carelessness not to see these problems which inevitably arise in each mechanical attempt to move the center of any scientific system – in the given case, from Schopenhauer’s doctrine of the will as the basis of the world to Marx’s doctrine about the dialectical development of matter.

But the worst is still to come. In such attempts one often simply must close one’s eyes to the contradictory facts, pay no attention to vast areas and main principles, and introduce monstrous distortions in both of the systems to be merged. In so doing, one uses transformations like those with which algebra operates, in order to prove the identity of two expressions. But the transformation of the systems to be merged operates with unities that are absolutely different from the algebraic ones. In practice, it always leads to the distortion of the essence of these systems.

In the article by Luria [1925, p. 55], for example, psychoanalysis is presented as “a system of monistic psychology,” whose methodology “coincides with the methodology” of Marxism. In order to prove this a number of most naive transformations of both systems are carried out as a result of which they “coincide.” Let us briefly look at these transformations. First of all, Marxism is situated in the general methodology of the epoch, alongside Darwin, Comte, Pavlov, and Einstein, who together create the general methodological foundations of the epoch. The role and importance of
each of these authors is, of course, deeply and fundamentally different, and by its very nature the role of dialectical materialism is totally different from all of them. Not to see this means to deduce methodology from the sum total of “great scientific achievements”. As soon as one reduces all these names and Marxism to a common denominator it is not difficult to unite Marxism with any “great scientific achievement,” because this was presupposed: the “coincidence” looked for is in the presupposition and not in the conclusion. The “fundamental methodology of the epoch” consists of the sum total of the discoveries made by Pavlov, Einstein, etc. Marxism is one of these discoveries, which belong to the “group of principles indispensable for quite a number of closely-related sciences” Here, on the first page, that is, the argumentation might have ended: after Einstein one would only have to mention Freud, for he is also a “great scientific achievement” and, thus, a participant in the “general methodological foundations of the epoch.” But one must have much uncritical trust in scientific reputation to deduce the methodology of an epoch from the sum total of famous names.

There is no unitary basic methodology of the epoch. What we have is a system of fighting, deeply hostile, mutually exclusive, methodological principles and each theory – whether by Pavlov or Einstein – has its own methodological merit. To distill a general methodology of the epoch and to dissolve Marxism in it means to transform not only the appearance, but also the essence of Marxism.

But also Freudian theory is inescapably subjected to the same type of transformations. Freud himself would be amazed to learn that psychoanalysis is a system of monistic psychology and that “methodologically he carries on... historical materialism” [Fridman, 1925, p. 159]. Not a single psychoanalytic journal would, of course, print the papers by Luria and Fridman. That is highly important. For a very peculiar situation has evolved: Freud and his school have never declared themselves to be monists, materialists, dialecticians, or followers of historical materialism. But they are told: you are both the first, and the second, and the third. You yourselves don’t know who you are. Of course, one can imagine such a situation, it is entirely possible. But then it is necessary to give an exact explanation of the methodological foundations of this doctrine, as conceived of and developed by its authors, and then a proof of the refutation of these foundations and to explain by what miracle and on what foundations psychoanalysis developed a system of methodology which is foreign to its authors. Instead of this, the identity of the two systems is declared by a simple formal-logical superposition of the characteristics – without a single analysis of Freud’s basic concepts, without critically weighing and elucidating his assumptions and starting points, without a critical examination of the genesis of his ideas, even without simply inquiring how he himself conceives of the philosophical foundations of his system. But, maybe, this formal-logical characterization of the two systems is correct? We have already seen how one distills Marxism’s share in the general methodology of the epoch, in which everything is roughly and naively reduced to a common denominator: if both Einstein and Pavlov and Marx belong to science, then they must have a common foundation. But Freudian theory suffers even more distortions in this process. I will not even mention how Zalkind (1924) mechanically deprives it of its central idea. In his article it is passed over in silence, which is also note worthy. But take the monism of psychoanalysis – Freud would contest it. The article mentions that he turned to philosophical monism, but where, in which words, in connection with what? Is finding empirical unity in some group of facts really always monism? On the contrary, Freud always accepted the mental, the unconscious as a special force which cannot be reduced to something else. Further, why is this monism materialistic in the philosophical sense? After all, medical materialism which acknowledges the influence of different organs etc. upon mental structures is still very far from philosophical materialism. In the philosophy of Marxism this concept has a specific, primarily epistemological sense and it is precisely in his epistemology that Freud stands on idealist philosophical grounds. For it is a fact, which is not refuted and not even considered by the authors of the “coincidences,” that Freud’s doctrine of the primary role of blind drives, of the unconscious as being reflected in consciousness in a distorted fashion, goes back directly to Schopenhauer’s
idealistic metaphysics of the will and the idea. Freud [1920/1973, pp. 49-50] himself remarks that in his extreme conclusions he is in the harbor of Schopenhauer. But his basic assumptions as well as the main lines of his system are connected with the philosophy of the great pessimist, as even the simplest analysis can demonstrate.

In its more “concrete” works as well, psychoanalysis displays not dynamic, but highly static, conservative, anti-dialectic and anti-historical tendencies. It directly reduces the higher mental processes – both personal and collective ones – to primitive, primordial, essentially prehistorical, prehuman roots, leaving no room for history. The same key unlocks the creativity of a Dostoyevsky and the totem and taboo of primordial tribes; the Christian church, communism, the primitive horde – in psychoanalysis everything is reduced to the same source. That such tendencies are present in psychoanalysis is apparent from all the works of this school which deal with problems of culture, sociology and history. We can see that here it does not continue, but contradicts, the methodology of Marxism. But about this one keeps silent as well.

Finally, the third point. Freud’s whole psychological system of fundamental concepts goes back to Lipps [1903]: the concepts of the unconscious, of the mental energy connected with certain ideas, of drives as the basis of the mind, of the struggle between drives and repression, of the affective nature of consciousness, etc. In other words, Freud’s psychological roots lead back to the spiritualistic strata of Lipps’ psychology. How is it possible to disregard this when speaking about Freud’s methodology?

Thus, we see where Freud and his system have come from and where they are heading for: from Schopenhauer and Lipps to Kolnay and mass psychology." But to apply the system of psychoanalysis while saying nothing about metapsychology, social psychology and Freud’s theory of sexuality is to give it a quite arbitrary interpretation. As a result, a person not knowing Freud would get an utterly false idea of him from such an exposition of his system. Freud himself would protest against the word “system” first of all. In his opinion, one of the greatest merits of psychoanalysis and its author is that it consciously avoids becoming a system. Freud himself rejects the “monism” of psychoanalysis: he does not demand that the factors he discovered be accepted as exclusive or primary. He does not at all attempt to “give an exhaustive theory of the mental life of man,” but demands only that his statements be used to complete and correct the knowledge which we have acquired through whatever other way. In another place he says that psychoanalysis is characterized by its technique and not by its subject matter, in a third that psychological theory has a temporary nature and will be replaced by an organic theory.

All this may easily delude us: it might seem that psychoanalysis really has no system and that its data can serve to correct and complete any system of knowledge, acquired in whatever way. But this is utterly false. Psychoanalysis has no a priori, conscious theory-system. Like Pavlov, Freud discovered too much to create an abstract system. But like Molière’s hero who, without suspecting it, spoke prose all his life, Freud, the investigator, created a system: introducing a new word, harmonizing one term with another, describing a new fact, drawing a new conclusion, he created, in passing and step by step, a new system. This implies that the structure of his system is unique, obscure, complex and very difficult to grasp. It is much easier to find one’s way in methodological systems which are deliberate, clear, and free from contradictions, which acknowledge their teachers and are unified and logically structured. It is much more difficult to correctly evaluate and reveal the true nature of unconscious methodologies which evolved spontaneously, in a contradictory way, under various influences. But it is precisely to the latter that psychoanalysis belongs. For this reason psychoanalysis requires a very careful and critical methodological analysis and not a naive superposition of the features of two different systems.

Ivanovský (1923, p. 249) says that “For a person who is not experienced in matters of scientific methodology all sciences seem to share the same method.” Psychology suffered most of all from such a misunderstanding. It was always counted as either biology or sociology and rarely were psychological laws, theories, etc., judged by the criterion of psychological methodology, i.e., with
an interest in the thought of psychological science as such, its theory, its methodology, its sources, forms and foundations. That is why in our critique of foreign systems, in the evaluation of their truth, we lack what is most important: after all, it is only from an understanding of its methodological basis that we can correctly assess the extent to which knowledge has been corroborated and established beyond doubt (Ivanovsky, 1923). And the rule that one must doubt everything, take nothing on trust, ask each claim what it rests on and what is its source, is, therefore, the first rule and methodology of science. It safeguards us against an even grosser mistake – not only to consider the methods of all sciences to be equal, but to imagine that the structure of each science is uniform.

The inexperienced mind imagines each separate science, so to speak, in one plane: given that science is reliable, indubitable knowledge, everything in it must be reliable. Its whole content must be obtained and proven by one and the same method which yields reliable knowledge. In reality this is not true at all: each science has its different facts (and groups of analogous facts) which have been established beyond doubt, its irrefutably established general claims and laws, but it also has pre-suppositions, hypotheses which sometimes have a temporary, provisional character and sometimes indicate the ultimate boundaries of our knowledge (at least for the given epoch); there are conclusions which follow more or less indubitably from firmly established theses; there are constructions which sometimes broaden the boundaries of our knowledge, sometimes form deliberately introduced ‘fictions’; there are analogies, approximate generalizations etc., etc. Science has no homogeneous structure and the understanding of this fact is of the greatest significance for a person's understanding of science. Each different scientific thesis has its own individual degree of reliability depending upon the way and degree of its methodological foundation, and science, viewed methodologically, does not represent a single solid uniform surface, but a mosaic of theses of different degrees of reliability” (ibid., p. 250).

That is why (1) merging the method of all sciences (Einstein, Pavlov, Comte, Marx) and (2) reducing the entire heterogeneous structure of the scientific system to one plane, to a “single solid uniform surface,” comprise the main mistakes of the second way of fusing two systems. To reduce personality to money; cleanliness, stubbornness and a thousand other, heterogeneous things to anal erotics (Luria, 1925), is not yet monism. And with regard to its nature and degree of reliability it is a fundamental error to mix up this thesis with the principles of materialism. The principle that follows from this thesis, the general idea behind it, its methodological meaning, the method of investigation prescribed by it, are deeply conservative: like the convict to his wheelbarrow, the character in psychoanalysis is chained to childhood erotics. Human life is in its inner essence predetermined by childhood conflicts. It is all the overcoming of the Oedipal conflict, etc. Culture and the life of mankind are again brought close to primitive life. [But] it is a first indispensable condition for analysis to be able to distinguish the first apparent meaning of a fact from its real meaning. By no means do I want to say that everything in psychoanalysis contradicts Marxism. I only want to say that I am in principle not dealing with this question at all. I am only pointing out how we should (methodologically) and should not (uncritically) fuse two systems of ideas.

With an uncritical approach, everybody sees what he wants to see and not what is: the Marxist finds monism, materialism, and dialectics in psychoanalysis, which is not there; the physiologist, like Lenz (1922, p. 69), holds that “psychoanalysis is a system which is psychological in name only; in reality it is objective, physiological.” And the methodologist Binswanger remarks in his work dedicated to Freud, as the only one amongst the psychoanalysts it seems, that precisely the psychological in his conception, i.e., the anti-physiological, constitutes Freud’s merit in psychiatry. But he adds [1922, p. v] that “this knowledge does not know itself yet, i.e., it has no insight into its own conceptual foundations, its logos.”

That is why it is especially difficult to study knowledge that has not yet become aware of itself and its own logos. This does by no means imply, of course, that Marxists should not study the unconscious because Freud’s basic concepts contradict dialectical materialism. On the contrary, precisely because the area elaborated by psychoanalysis is elaborated with inadequate means it must
be conquered for Marxism. It must be elaborated with the means of a genuine methodology, for otherwise, if everything in psychoanalysis would coincide with Marxism, psychologists might develop it in their quality as psychoanalysts and not as Marxists. And for this elaboration one must first take account of the methodological nature of each idea, each thesis. And under this condition the most metapsychological ideas can be interesting and instructive, for example, Freud’s doctrine of the death drive.

In the preface which I wrote for the translation of Freud’s book on this theme, I attempted to show that the fictitious construct of a death drive – despite the whole speculative nature of this thesis, the not very convincing nature of the factual confirmations (traumatic neurosis and the repetition of unpleasant experiences in children’s play), its giddy paradoxical nature and the contradiction of generally accepted biological ideas, its conclusions which obviously coincide with the philosophy of the Nirvana, despite all this and despite the whole artificial nature of the concept – satisfies the need of modern biology to master the idea of death, just like mathematics in its time needed the concept of the negative number. I adduced the thesis that the concept of life has been carried to great clarity in biology, science has mastered it, it knows how to work with it, how to investigate and understand living matter. But it cannot yet cope with the concept of death. Instead of this concept we have a gaping hole, an empty spot. Death is merely seen as the contradictory opposite of life, as not-life, in short, as non-being. But death is a fact that has its positive sense as well, it is a special type of being and not merely non-being. It is a specific something and not absolutely nothing. And biology does not know this positive sense of death. Indeed, death is a universal law for living matter. One cannot imagine that this phenomenon would in no way be represented in the organism, i.e., in the processes of life. It is hard to believe that death would have no sense or just a negative sense.

Engels [1925/1978, p. 554] expresses a similar opinion. He refers to Hegel’s opinion that only that philosophy can count as scientific that considers death to be an essential aspect of life and understands that the negation of life is essentially contained in life itself, so that life can be understood in relation to its inevitable result which is continually present in embryonic form: death. The dialectical understanding of life entails no more than that. “To live means to die.”

It was precisely this idea that I defended in the mentioned preface to Freud’s book: the need for biology to master the concept of death from a fundamental viewpoint and to designate this still unknown entity which no doubt exists – let it be with the algebraic “x” or the paradoxical “death drive” – and which represents the tendency towards death in the processes of the organism. Despite this I did not declare Freud’s solution to this equation to be a highway in science or a road for all of us, but an Alpine mountain track above the precipice for those free of vertigo. I stated that science needs such books as well: they do not reveal the truth, but teach us the search for truth, although they have not yet found it. I also resolutely said that the importance of this book does not depend upon the factual confirmation of its reliability: in principle it asks the right question. And for the statement of such questions, I said, one needs sometimes more creativity than for the umpteenth standard observation in whatever science (see pp. 13-15 of Van der Veer and Valsiner, 1994).

And the judgment of one of the reviewers of this book showed a complete lack of understanding of the methodological problem, a full trust in the external features of ideas, a naive and uncritical fear of the physiology of pessimism. He decided on the spot that if it is Schopenhauer, it must be pessimism. He did not understand that there are problems that one cannot approach flying, but that one must approach on foot, limping, and that in such cases it is no shame to limp, as Freud [1920/1973, p. 64] openly says. But he, who only sees lameness here, is methodologically blind. For it would not be difficult to show that Hegel is an idealist, it is proclaimed from the housetops. But it needed genius to see in this system an idealism that stood materialism on its head, i.e., to distinguish the methodological truth (dialectics) from the factual falsehood, to see that Hegel went limping towards the truth.

This is but a single example of the path towards the mastery of scientific ideas: one must rise above
their factual content and test their fundamental nature. But for this one needs to have a buttress outside these ideas. Standing upon these ideas with both feet, operating with concepts gathered by means of them, it is impossible to situate oneself outside of them. In order to critically regard a foreign system; one must first of all have one’s own psychological system of principles. To judge Freud by means of principles obtained from Freud himself implies a vindication in advance. And such an attempt to appropriate foreign ideas forms the third type of combining ideas to which we will now turn.

Again it is easiest to disclose and demonstrate the character of the new methodological approach with a single example. In Pavlov’s laboratory it was attempted to experimentally solve the problem of the transformation of trace-conditional stimuli and trace conditional inhibitors into actual conditional stimuli. For this one must “banish the inhibition” established through the trace reflex. How to do this? In order to reach this goal, Pavlov resorted to an analogy with some of the methods of Freud’s school. Trying to destroy the stable inhibitory complexes, he exactly recreated the situation in which these complexes were originally established. And the experiment succeeded. I consider the methodological technique at the basis of this experiment to be an example of the right approach to Freud’s theme and to claims by others in general. Let us try to describe this technique. First of all, the problem was raised in the course of Pavlov’s own investigations of the nature of internal inhibition. The task was framed, formulated, and understood in the light of his principles. The theoretical theme of the experimental work and its significance were conceived of in the concepts of Pavlov’s school. We know what a trace reflex is and we also know what an actual reflex is. To transform the one into the other means to banish inhibition etc., i.e., the whole mechanism of the process we understand in entirely specific and homogeneous categories. The value of the analogy with catharsis was merely heuristic: it shortened the path of Pavlov’s experiments and led to the goal in the shortest way possible. But it was only accepted as an assumption that was immediately verified experimentally. And after the solution of his own task the author came to the third and final conclusion that the phenomena described by Freud can be experimentally tested upon animals and should be analyzed in more detail via the method of conditional salivary reflexes.

To verify Freud via Pavlov’s ideas is totally different from verifying them via his own ideas; and this possibility as well was established not through analysis, but through the experiment. What is most important is that the author, when confronted with phenomena analogous to those described by Freud’s school, did not for one moment step onto foreign territory, did not rely on other people’s data, but used them to carry through his own investigation. Pavlov’s discovery has its significance, value, place and meaning in his own system, not in Freud’s. The two circles touch at the point of intersection of both systems, the point where they meet, and this one point belongs to both at the same time. But its place, sense and value is determined by its position in the first system. A new discovery was made in this investigation, a new fact was found, a new trait was studied – but it was all in the framework of the theory of conditional reflexes and not in psychoanalysis. In this way each “almost miraculous” coincidence disappeared!

One has only to compare this with the purely verbal way Bekhterev [1932, p.413] comes to a similar evaluation of the idea of catharsis for the system of reflexology, to see the deep difference between these two procedures. Here the interrelation of the two systems is also first of all based on catharsis, i.e.,

- discharge of a ‘strangulated’ affect or an inhibited mimetic-somatic impulse. Is not this the discharge of a reflex which, when inhibited, oppresses the personality, shackles and diseases it, while, when there is discharge of the reflex (catharsis), naturally the pathological condition disappears? Is not the weeping out of a sorrow the discharge of an impeded reflex?

Here every word is a pearl. A mimetic-somatic impulse – what can be more clear or precise? Avoiding the language of subjective psychology, Bekhterev is not squeamish about philistine language, which hardly makes Freud’s term any clearer. How did this inhibited reflex “oppress” the personality, shackles it? Why is the wept-out sorrow the discharge of an inhibited reflex? What if a
person weeps in the very moment of sorrow? Finally, elsewhere it is claimed that thought is an inhibited reflex, that concentration is connected with the inhibition of a nervous current and is accompanied by conscious phenomena. Oh salutary inhibition! It explains conscious phenomena in one chapter and unconscious ones in the next!

All this clearly indicates the theme with which we started this section: in the problem of the unconscious one must distinguish between a methodological and an empirical problem, i.e., between a psychological problem and the problem for psychology. The uncritical combination of both problems leads to a gross distortion of the whole matter. The symposium on the unconscious showed that a fundamental solution of this matter transcends the boundaries of empirical psychology and is directly tied to general philosophical convictions. Whether we accept with Brentano that the unconscious does not exist, or with Munsterberg that it is simply physiology, or with Schubert – Soldern that it is an epistemologically indispensable category, or with Freud that it is sexual – in all these cases our argumentation and conclusions transcend the boundaries of empirical psychology.

Among the Russian authors it is Dale who emphasizes the epistemological motives which led to the formation of the concept of the unconscious. In his opinion it is precisely the attempt to defend the independence of psychology as an explanatory science against the usurpation of physiological methods and principles that is the basis of this concept. The demand to explain the mental from the mental, and not from the physical, that psychology in the analysis and description of the facts should stay itself, within its own boundaries, even if this implied that one had to enter the path of broad hypotheses – this is what gave rise to the concept of the unconscious. Dale observes that psychological constructions or hypotheses are no more than the theoretical continuation of the description of homogeneous phenomena in one and the same independent system of reality. The tasks of psychology and theoretical-epistemological demands require that it fight the usurpationist attempts of physiology by means of the unconscious. Mental life proceeds with interruptions, it is full of gaps. What happens with consciousness during sleep, with reminiscences that we do not now recollect, with ideas of which we are not consciously aware at the moment? In order to explain the mental from the mental, in order not to turn to another domain of phenomena – physiology – to fill the pauses, gaps and blanks in mental life, we must assume that they continue to exist in a special form: as the unconscious mental. Stern [1919, pp. 241-243] as well develops such a conception of the unconscious as both an essential assumption and a hypothetical continuation and complement to mental experience.

Dale distinguishes two aspects of the problem: the factual and the hypothetical or methodological, which determines the epistemological or methodological value of the category of the unconscious for psychology. Its task is to clarify the meaning of this concept, the domain of phenomena it covers, and its role for psychology as an explanatory science. Following Jerusalem [33], for the author it is first of all a category or a way of thinking which is indispensable in the explanation of mental life. Apart from that, it is also a specific area of phenomena. He is completely right in saying that the unconscious is a concept created on the basis of indisputable mental experience and its necessary hypothetical completion. Hence the very complex nature of each statement operating with this concept: in each statement one must distinguish what comes from the data of indisputable mental experience, what comes from the hypothetical completion, and what is the degree of reliability of both. In the critical works examined above, the two things, both sides of the problem, have been mixed up: hypothesis and fact, principle and empirical observation, fiction and law, construction and generalization – it is all lumped together.

Most important of all is the fact that the main question was left out of consideration. Lenz and Luria assure Freud that psychoanalysis is a physiological system. But Freud himself belongs to the opponents of a physiological conception of the unconscious. Dale is completely right in saying that this question of the psychological or physiological nature of the unconscious is the primarily, most important phase of the whole problem. Before we describe and classify the phenomena of the unconscious for psychological purposes, we must know whether we are operating with something
physiological or with something mental. We must prove that the unconscious in fact is a mental reality. In other words, before we turn to the solution of the problem of the unconscious as a psychological problem, we must first solve it as the problem for psychology.

**Chapter 8**

The need for a fundamental elaboration of the concepts of the general science – this algebra of the particular sciences – and its role for the particular sciences is even more obvious when we borrow from the area of other sciences. Here, on the one hand, it would seem that we have the best conditions for transferring results from one science into the system of another one, because the reliability, clarity and the degree to which the borrowed thesis or law have been fundamentally elaborated are usually much higher than in the cases we have described. We may, for example, introduce into the system of psychological explanation a law established in physiology or embryology, a biological principle, an anatomical hypothesis, an ethnological example, a historical classification etc. The theses and constructions of these highly developed, firmly grounded sciences are, of course, methodologically elaborated in an infinitely more precise way than the theses of a psychological school which by means of newly created and not yet systematized concepts is developing completely new areas (for example, Freud’s school, which does not yet know itself). In this case we borrow a more elaborated product, we operate with better-defined, exact, and clear unities; the danger of error has diminished, the likelihood of success has increased.

On the other hand, as the borrowing here comes from other sciences, the material turns out to be more foreign, methodologically heterogeneous, and the conditions for appropriating it become more difficult. This fact, that the conditions are both easier and more difficult compared with what we examined above, provides us with an essential method of variation in theoretical analysis which takes the place of real variation in the experiment.

Let us dwell upon a fact which at first sight seems highly paradoxical and which is therefore very suitable for analysis. Reflexology, which in all areas finds such wonderful coincidences of its data with the data of subjective analysis and which wishes to build its system on the foundation of the exact natural sciences, is, very surprisingly, forced to protest precisely against the transfer of natural scientific laws into psychology.

After studying the method of genetic reflexology, Shchelovanov, with an indisputable thoroughness quite unexpected for his school – rejected the imitation of the natural sciences in the form of a transfer of its basic methods into subjective psychology. Their application in the natural sciences has produced tremendous results, but they are of little value for the elaboration of the problems of subjective psychology. Herbart and Fechner mechanically transferred mathematical analysis and Wundt the physiological experiment into psychology. Preyer raised the problem of psychogenesis by analogy with biology and then Hall and others borrowed the Muller-Haeckel principle from biology and applied it in an uncontrolled way not only as a methodological principle, but also as a principle for the explanation of the “mental development” of the child. It would seem, says the author, that we cannot object to the application of well tried and fruitful methods. But their use is only possible when the problem is correctly stated and the method corresponds to the nature of the object under study. Otherwise one only gets the illusion of science (the characteristic example is Russian reflexology). The veil of natural science which was, according to Petzoldt, thrown over the most backward metaphysics, saved neither Herbart nor Wundt: neither the mathematical formulas nor the precision equipment saved an imprecisely stated problem from failure.

We are reminded of Munsterberg and his remark about the last decimal point given in the answer to an incorrectly stated question. In biology, clarifies the author, the biogenetic law is a theoretical generalization of masses of facts, but its application in psychology is the result of superficial speculation, exclusively based upon an analogy between different domains of facts (Does not reflexology do the same? Without investigation of its own it borrows, using similar speculations, the
ready-made models for its own constructions from the living and the dead – from Einstein and from
Freud). And then, to crown this pyramid of mistakes, the principle is not applied as a working
hypothesis, but as an established theory, as if it were scientifically established as an explanatory
principle for the given area of facts.

We will not deal with this matter, as does the author of this opinion, in great detail. There is
abundant, including Russian, literature on it. We will examine it to illustrate the fact that many
questions which have been incorrectly stated by psychology acquire the outward appearance of
science due to borrowings from the natural sciences. As a result of his methodological analysis,
Shchelovanov comes to the conclusion that the genetic method is in principle impossible in
empirical psychology and that because of this the relations between psychology and biology
become changed. But why was the problem of development stated incorrectly in child psychology,
which led to a tremendous and useless expenditure of effort? In Shchelovanov’s opinion, child
psychology can yield nothing other than what is already contained in general psychology. But
general psychology as a unified system does not exist, and these theoretical contradictions make a
child psychology impossible. In a very disguised form, imperceptible to the investigator himself, the
theoretical presuppositions fully determine the whole method of processing the empirical data. And
the facts gathered in observation, too, are interpreted in accordance with the theory which this or
that author holds. Here is the best refutation of the sham natural science empiricism. Thanks to this,
it is impossible to transfer facts from one theory to another. It would seem that a fact is always a
fact, that one and the same subject matter – the child – and one and the same method – objective
observation – albeit combined with different objectives and starting points, allow us to transfer facts
from psychology to reflexology. The author is mistaken in only two respects.

His first mistake resides in the assumption that child psychology got its positive results only by
applying general biological, but not psychological principles, as in the theory of play developed by
Groos [1899]. In reality, this is one of the best examples not of borrowing, but of a purely
psychological, comparative-objective study. It is methodologically impeccable and transparent,
internally consistent from the first collection and description of the facts to the final theoretical
generalizations. Groos gave biology a theory of play created with a psychological method. He did
not take it from biology; he did not solve his problem in the light of biology, i.e., he did not set
himself general psychological goals as well. Thus, exactly the opposite is correct: child psychology
obtained valuable theoretical results precisely when it did not borrow, but went its own way. The
author himself is constantly arguing against borrowing. Hall, who borrowed from Haeckel, gave
psychology a number of curious topics and far-fetched senseless analogies, but Groos, who went his
own way, gave much to biology – not less than Haeckel’s law. Let me also remind you of Stern’s
theory of language, Buhler’s and Koffka’s theory of children’s thinking, Buhler’s theory of
developmental levels, Thorndike’s theory of training: these are all psychological theories of the
purest water. Hence the mistaken conclusion: the role of child psychology cannot be reduced, of
course, to the gathering of factual data and their preliminary classification, i.e., to the preparatory
work. But the role of the logical principles developed by Shchelovanov and Bekhterev can and must
precisely be reduced to this. After all, the new discipline has no idea of childhood, no conception of
development, no research goal, i.e., it does not state the problem of child behavior and personality,
but only disposes of the principle of objective observation, i.e., a good technical rule. However,
using this weapon nobody has drawn out any great truths.

The author’s second mistake is connected with this. The lack of understanding of the positive value
of psychology and the underestimation of its role results from the most important and
methodologically childish idea that one can study only what is given in immediate experience. His
whole “methodological” theory is built upon a single syllogism: (1) psychology studies
consciousness; (2) given in immediate experience is the consciousness of the adult; “the empirical
study of the phylogenetic and ontogenetic development of consciousness is impossible”; (3)
therefore, child psychology is impossible.

But it is a gross mistake to suppose that science can only study what is given in immediate
experience. How does the psychologist study the unconscious; the historian and the geologist, the past; the physicist-optician, invisible beams, and the philologist – ancient languages? The study of traces, influences, the method of interpretation and reconstruction, the method of critique and the finding of meaning have been no less fruitful than the method of direct “empirical” observation. Ivanovsky used precisely the example of psychology to explain this for the methodology of science. Even in the experimental sciences the role of immediate experience becomes smaller and smaller. Planck says that the unification of the whole system of theoretical physics is reached due to the liberation from anthropomorphic elements, in particular from specific sense perceptions. Planck [1919/1970, p. 118] remarks that in the theory of light and in the theory of radiant energy in general, physics works with such methods that:

the human eye is totally excluded, it plays the role of an accidental, admittedly highly sensitive but very limited reagent; for it only perceives the light beams within a small area of the spectrum which hardly attains the breadth of one octave. For the rest of the spectrum the place of the eye is taken by other perceiving and measuring instruments, such as, for example, the wave detector, the thermometer, the bolometer, the radiometer, the photographic plate, the ionization chamber. The separation of the basic physical concept from the specific sensory sensation was accomplished, therefore, in exactly the same way as in mechanics where the concept of force has long since lost its original link with muscular sensations.

Thus, physics studies precisely what cannot be seen with the eye. For if we, like the author, agree with Stern [1914, p. 7] that childhood is for us “a paradise lost forever,” that for us adults it is impossible to “fully penetrate in the special properties and structure of the child’s mind” as it is not given in direct experience, we must admit that the light beams which cannot be directly perceived by the eye are a paradise lost forever as well, the Spanish inquisition a hell lost forever, etc., etc.. But the whole point is that scientific knowledge and immediate perception do not coincide at all. We can neither experience the child’s impressions, nor witness the French revolution, but the child who experiences his paradise with all directness and the contemporary who saw the major episodes of the revolution with his own eyes are, despite that, farther from the scientific knowledge of these facts than we are. Not only the humanities, but the natural sciences as well, build their concepts in principle independently from immediate experience. We are reminded of Engels’ words about the ants and the limitations of our eye.

How do the sciences proceed in the study of what is not immediately given? Generally speaking, they reconstruct it, they re-create the subject of study through the method of interpreting its traces or influences, i.e., indirectly. Thus, the historian interprets traces – documents, memoirs, newspapers, etc. – and nevertheless history is a science about the past, reconstructed by its traces, and not a science about the traces of the past, it is about the revolution and not about documents of the revolution. The same is true for child psychology. Is childhood, the child’s mind, really inaccessible for us, does it not leave any traces, does it not manifest or reveal itself? It is just a matter of how to interpret these traces, by what method. Can they be interpreted by analogy with the traces of the adult? It is, therefore, a matter of finding the right interpretation and not of completely refraining from any interpretation. After all, historians too are familiar with more than one erroneous construct based upon genuine documents which were falsely interpreted. What conclusion follows from this? Is it really that history is “a paradise forever lost”? But the same logic that calls child psychology a paradise lost would compel us to say this about history as well. And if the historian, or the geologist, or the physicist were to argue like the reflexologist, they would say: as we cannot immediately experience the past of mankind and the earth (the child’s mind) and can only immediately experience the present (the adult’s consciousness) – which is why many falsely interpret the past by analogy with the present or as a small present (the child as a small adult) – history and geology are subjective, impossible. The only thing possible is a history of the present (the psychology of the adult person). The history of the past can only be studied as the science of the traces of the past, of the documents etc. as such, and not of the past as such (through the methods of studying reflexes without any attempt at interpreting them).
This dogma – of immediate experience as the single source and natural boundary of scientific knowledge – in principle makes or breaks the whole theory of subjective and objective methods. Vvedensky and Bekhterev grow from a single root: both hold that science can only study what is given in self-observation, i.e., in the immediate perception of the psychological. Some rely on the mental eye and build a whole science in conformity with its properties and the boundaries of its action. Others do not rely on it and only wish to study what can be seen with the real eye. This is why I say that reflexology, methodologically speaking, is built entirely according to the principle that history should be defined as the science of the documents of the past. Due to the many fruitful principles of the natural sciences, reflexology proved to be a highly progressive current in psychology, but as a theory of method it is deeply reactionary, because it leads us back to the naive sensualistic prejudice that we can only study what can be perceived and to the extent we perceive it. Just as physics is liberating itself from anthropomorphic elements, i.e., from specific sensory sensations and is proceeding with the eye fully excluded, so psychology must work with the concept of the mental: direct self-observation must be excluded like muscular sensation in mechanics and visual sensation in optics. The subjectivists believe that they refuted the objective method when they showed that genetically speaking the concepts of behavior contain a grain of self-observation – c.f. Chelpanov (1925), Kravkov (1922), Portugalov (1925).[22] But the genetic origin of a concept says nothing about its logical nature: genetically, the concept of force in mechanics also goes back to muscular sensation.

The problem of self-observation is a problem of technique and not of principle. It is an instrument amidst a number of other instruments, as the eye is for physicists. We must use it to the extent that it is useful, but there is no need to pronounce judgments of principle about it – e.g., about the limitations of the knowledge obtained with it, its reliability, or the nature of the knowledge determined by it. Engels demonstrated how little the natural construction of the eye determines the boundaries of our knowledge of the phenomena of light. Planck says the same on behalf of contemporary physics. To separate the fundamental psychological concept from the specific sensory perception is psychology’s next task. This sensation itself, self-observation itself, must be explained (like the eye) from the postulates, methods, and universal principles of psychology. It must become one of psychology’s particular problems.

When we accept this, the question of the nature of interpretation, i.e., the indirect method, arises. Usually it is said that history interprets the traces of the past, whereas physics observes the invisible as directly as the eye does by means of its instruments. The instruments are the extended organs of the researcher. After all, the microscope, telescope, telephone etc. make the invisible visible and the subject of immediate experience. Physics does not interpret, but sees.

But this opinion is false. The methodology of the scientific instrument has long since clarified a new role for the instrument which is not always obvious. Even the thermometer may serve as an example of the introduction of a fundamentally new principle into the method of science through the use of an instrument. On the thermometer we read the temperature. It does not strengthen or extend the sensation of heat as the microscope extends the eye; rather, it totally liberates us from sensation when studying heat. One who is unable to sense heat or cold may still use the thermometer, whereas a blind person cannot use a microscope. The use of a thermometer is a perfect model of the indirect method. After all, we do not study what we see (as with the microscope) – the rising of the mercury, the expansion of the alcohol – but we study heat and its changes, which are indicated by the mercury or alcohol. We interpret the indications of the thermometer, we reconstruct the phenomenon under study by its traces, by its influence upon the expansion of a substance. All the instruments Planck speaks of as means to study the invisible are constructed in this way. ‘To interpret, consequently, means to re-create a phenomenon from its traces and influences relying upon regularities established before (in the present case – the law of the extension of solids, liquids, and gases during heating). There is no fundamental difference whatsoever between the use of a thermometer on the one hand and interpretation in history, psychology, etc. on the other. The same holds true for any science: it is not dependent upon sensory
Stumpf mentions the blind mathematician Saunderson who wrote a textbook of geometry; Shcherbina (1908) relates that his blindness did not prevent him from explaining optics to sighted people. And, indeed, all instruments mentioned by Planck can be adapted for the blind, just like the watches, thermometers, and books for the blind that already exist, so that a blind person might occupy himself with optics as well. It is a matter of technique, not of principle.

Korniov (1922) beautifully demonstrated that (1) disagreement about the procedural aspect of the design of experiments makes for conflicts which lead to the formation of different currents in psychology, just as the different philosophies about the chronoscope – which resulted from the question as to in which room this apparatus should be placed during the experiments – determined the question of the whole method and system of psychology and divided Wundt’s school from Kulpe’s; and (2) the experimental method introduced nothing new into psychology. For Wundt it is a correction of self-observation. For Ach the data of self-observation can only be checked against other data of self-observation, as if the sensation of heat can be checked only against other sensations. For Deichler the quantitative estimations give a measure for the correctness of introspection. In sum, experiment does not extend our knowledge, it checks it. Psychology does not yet have a methodology of its equipment and has not yet raised the question of an apparatus which would – like the thermometer – liberate us from introspection rather than check or amplify it. The philosophy of the chronoscope is a more difficult matter than its technique. But about the indirect method in psychology we will come to speak more than once.

Zelenyj (1923) is right in pointing out that in Russia the word “method” means two different things: (1) the research methods, the technology of the experiment; and (2) the epistemological method, or methodology, which determines the research goal, the place of the science, and its nature. In psychology the epistemological method is subjective, although the research methods may be partially objective. In physiology the epistemological method is objective, although the research methods may be partially subjective as in the physiology of the sense organs. Let us add that the experiment reformed the research methods, but not the epistemological method. For this reason, he says that the psychological method can only have the value of a diagnostic device in the natural sciences.

This question is crucial for all methodological and concrete problems of psychology. For psychology the need to fundamentally transcend the boundaries of immediate experience is a matter of life and death. The demarcation, separation of the scientific concept from the specific perception, can take place only on the basis of the indirect method. The reply that the indirect method is inferior to the direct one is in scientific terms utterly false. Precisely because it does not shed light upon the plentitude of experience, but only on one aspect, it accomplishes scientific work: it isolates, analyzes, separates, abstracts a single feature. After all, in immediate experience as well we isolate the part that is the subject of our observation. Anyone who deplores the fact that we do not share the ant’s immediate experience of chemical beams is beyond help, says Engels, for on the other hand we know the nature of these beams better than ants do. The task of science is not to reduce everything to experience. If that were the case it would suffice to replace science with the registration of our perceptions. Psychology’s real problem resides also in the fact that our immediate experience is limited, because the whole mind is built like an instrument which selects and isolates certain aspects of phenomena. An eye that would see everything, would for this very reason see nothing. A consciousness that was aware of everything would be aware of nothing, and knowledge of the self, were it aware of everything, would be aware of nothing. Our knowledge is confined between two thresholds, we see but a tiny part of the world. Our senses give us the world in the excerpts, extracts that are important for us. And in between the thresholds it is again not the whole variety of changes which is registered, and new thresholds exist. Consciousness follows nature in a saltatory fashion as it were, with blanks and gaps. The mind selects the stable points of reality amidst the universal movement. It provides islands of safety in the Heraclitean stream. It is an organ of selection, a sieve filtering the world and changing it so that it becomes possible to act.
In this resides its positive role – not in reflection (the non-mental reflects as well; the thermometer is more precise than sensation), but in the fact that it does not always reflect correctly, i.e., subjectively distorts reality to the advantage of the organism.

If we were to see everything (i.e., if there were no absolute thresholds) including all changes that constantly take place (i.e., if no relative thresholds existed), we would be confronted with chaos (remember how many objects a microscope reveals in a drop of water). What would be a glass of water? And what a river? A pond reflects everything; a stone reacts in principle to everything. But these reactions equal the stimulation: *causa aequat effectum*. [34] The reaction of the organism is “richer”: it is not like an effect, it expends potential forces, it selects stimuli. Red, blue, loud, sour – it is a world cut into portions. Psychology’s task is to clarify the advantage of the fact that the eye does not perceive many of the things known to optics. From the lower forms of reactions to the higher ones there leads, as it were, the narrowing opening of a funnel.

It would be a mistake to think that we do not see what is for us biologically useless. Would it really be useless to see microbes? The sense organs show clear traces of the fact that they are in the first place organs of selection. Taste is obviously a selection organ for digestion, smell is part of the respiratory process. Like the customs checkpoints at the border, they test the stimuli coming from outside. Each organ takes the world *cum grano salis* – with a coefficient of specification, as Hegel says, [and] with an indication of the relation, where the quality of one object determines the intensity and character of the quantitative influence of another quality. For this reason there is a complete analogy between the selection of the eye and the further selection of the instrument: both are organs of selection (accomplish what we accomplish in the experiment). So that the fact that scientific knowledge transcends the boundaries of perception is rooted in the psychological essence of knowledge itself.

From this it follows that as methods for judging scientific truth, direct evidence and analogy are in principle completely identical. Both must be subjected to critical examination; both can deceive and tell the truth. The direct evidence that the sun turns around the earth deceives us; the analogy upon which spectral analysis is built, leads to the truth. On these grounds some have rightly defended the legitimacy of analogy as a basic method of zoo-psychology. This is fully acceptable, one must only point out the conditions under which the analogy will be correct. So far the analogy in zoo-psychology has led to anecdotes and curious incidents, because it was observed where it actually cannot exist. It can, however, also lead to spectral analysis. That is why methodologically speaking the situation in physics and psychology is in principle the same. The difference is one of degree.

The mental sequence we experience is a fragment: where do all the elements of mental life disappear and where do they come from? We are compelled to continue the known sequence with a hypothetical one. It was precisely in this sense that Høffding [1908, p. 92/114] introduced this concept which corresponds with the concept of potential energy in physics. This is why Leibnitz[26] introduced the infinitely small elements of consciousness [cf. Høffding, 1908, p. 108].

We are forced to continue the life of consciousness into the unconscious in order not to fall into absurdities [ibid., p. 286].

However, for Høffding (ibid., p. 117) “the unconscious is a boundary concept in science” and at this boundary we may “weigh the possibilities” through a hypothesis, but:

a real extension of our factual knowledge is impossible. ... Compared to the physical world, we experience the mental world as a fragment; only through a hypothesis can we supplement it.

But even this respect for the boundary of science seems to other authors insufficient. About the unconscious it is only allowed to say that it exists. By its very definition it is not an object for experimental verification. To argue its existence by means of observations, as Høffding attempts, is illegitimate. This word has two meanings, there are two types of unconscious which we must not mix up – the debate is about a two-fold subject: about the hypothesis and about the facts that can be observed.
One more step in this direction, and we return to where we started: to the difficulty that compelled us to hypothesize an unconscious.

We can see that psychology finds itself here in a tragicomic situation: I want to, but I cannot. It is forced to accept the unconscious so as not to fall into absurdities. But accepting it, it falls into even greater absurdities and runs back in horror. It is like a man who, running from a wild animal and into an even greater danger, runs back to the wild animal, the lesser danger – but does it really make any difference from what he dies? Wundt views in this theory an echo of the mystical philosophy of nature [Naturphilosophie] of the early 19th century. With him Lange (1914, p. 251) accepts that the unconscious mind is an intrinsically contradictory concept. The unconscious must be explained physically and chemically and not psychologically, else we allow “mystical agents,” “arbitrary constructions that can never be verified,” to enter science.

Thus, we are back to Høffding: there is a physico-chemical sequence, which in some fragmentary points is suddenly a nihilo accompanied by a mental sequence. Please, be good enough to understand and scientifically interpret the “fragment.” What does this debate mean for the methodologist? We must psychologically transcend the boundary of immediately perceived consciousness and continue it, but in such a way as to separate the concept from sensation. Psychology as the science of consciousness is in principle impossible. As the science of the unconscious mind it is doubly impossible. It would seem that there is no way out, no solution for this quadrature of the circle. But physics finds itself in exactly the same position. Admittedly, the physical sequence extends further than the mental one, but this sequence is not infinite and without gaps either. It was science that made it in principle continuous and infinite and not immediate experience. It extended this experience by excluding the eye. This is also psychology’s task.

Hence, interpretation is not only a bitter necessity for psychology, but also a liberating and essentially most fruitful method of knowledge, a salto vitale, which for bad jumpers turns into a salto mortale. Psychology must develop its philosophy of equipment, just as physics has its philosophy of the thermometer. In practice both parties in psychology have recourse to interpretation: the subjectivist has in the end the words of the subject, i.e., his behavior and mind are interpreted behavior. The objectivist will inevitably interpret as well. The very concept of reaction implies the necessity of interpretation, of sense, connection, relation. Indeed, actio and reactio are concepts that are originally mechanistic – one must observe both and deduce a law. But in psychology and physiology the reaction is not equal to the stimulus. It has a sense, a goal, i.e., it fulfills a certain function in the larger whole. It is qualitatively connected with its stimulus. And this sense of the reaction as a function of the whole, this quality of the interrelation, is not given in experience, but found by inference. To put it more easily and generally: when we study behavior as a system of reactions, we do not study the behavioral acts in themselves (by the organs), but in their relation to other acts – to stimuli. But the relation and the quality of the relation, its sense, are never the subject of immediate perception, let alone the relation between two heterogeneous sequences – between stimuli and reactions. The following is extremely important: the reaction is an answer. An answer can only be studied according to the quality of its relation with the question, for this is the sense of answer which is not found in perception but in interpretation.

This is the way everybody proceeds.

Bekhterev distinguishes the creative reflex. A problem is the stimulus, and creativity is the response reaction or a symbolic reflex. But the concepts of creativity and symbol are semantic concepts, not experiential ones: a reflex is creative when it stands in such a relation to a stimulus that it creates something new; it is symbolic when it replaces another reflex. But we cannot see the symbolic or creative nature of a reflex.

Pavlov distinguishes the reflexes of freedom and purpose, the food reflex and the defense reflex. But neither freedom nor purpose can be seen, nor do they have an organ like, for example, the organs for nutrition; nor are they functions. They consist of the same movements as the other ones. Defense, freedom, and purpose – they are the meanings of these reflexes.
Kornilov distinguishes emotional reactions, selective, associative reactions, the reaction of recognition, etc. It is again a classification according to their meaning, i.e., on the basis of the interpretation of the relation between stimulus and response.

Watson, accepting similar distinctions based on meaning, openly says that nowadays the psychologist of behavior arrives by sheer logic at the conclusion that there is a hidden process of thinking. By this he is becoming conscious of his method and brilliantly refutes Titchener, who defended the thesis that the psychologist of behavior, exactly because of being a psychologist of behavior, cannot accept the existence of a process of thinking when he is not in the situation to observe it immediately and must use introspection to reveal thinking. Watson demonstrated that he in principle isolates the concept of thinking from its perception in introspection, just like the thermometer emancipates us from sensation when we develop the concept of heat. That is why he [1926, p. 301] emphasizes:

If we ever succeed in scientifically studying the intimate nature of thought. ... then we will owe this to a considerable extent to the scientific apparatus.

However even now the psychologist is not in such a deplorable situation: physiologists as well are often satisfied with the observation of the end results and utilize logic. ... The adherent of the psychology of behavior feels that with respect to thinking he must keep to exactly the same position [ibid., p. 302].

Meaning as well is for Watson an experimental problem. We find it in what is given to us through thinking.

Thorndike (1925) distinguishes the reactions of feeling, conclusion, mood, and cunning. Again [we are dealing with] interpretation.

The whole matter is simply how to interpret – by analogy with one’s introspection, biological functions, etc. That is why Koffka [1925, pp. 10/13] is right when he states: There is no objective criterion for consciousness, we do not know whether an action has consciousness or not, but this does not make us unhappy at all. However, behavior is such that the consciousness belonging to it, if it exists at all, must have such and such a structure. Therefore behavior must be explained in the same way as consciousness. Or in other words, put paradoxically: if everybody had only those reactions which can be observed by all others, nobody could observe anything, i.e., scientific observation is based upon transcending the boundaries of the visible and upon a search for its meaning which cannot be observed. He is right. He was right [Koffka, 1924, pp. 152/160] when he claimed that behaviorism is bound to be fruitless when it will study only the observable, when its ideal is to know the direction and speed of the movements of each limb, the secretion of each gland, resulting from a fixed stimulation. Its area would then be restricted to the physiology of the muscles and the glands. The description “this animal is running away from some danger,” however insufficient it may be, is yet a thousand times more characteristic for the animal’s behavior than a formula giving us the movements of all its legs with their varying speeds, the curves of breath, pulse, and so forth.

Köhler (1917) demonstrated in practice how we may prove the presence of thinking in apes without any introspection and even study the course and structure of this process through the method of the interpretation of objective reactions. Kornilov (1922) demonstrated how we may measure the energetic budget of different thought operations using the indirect method: the dynamoscope is used by him as a thermometer. Wundt’s mistake resided in the mechanical application of equipment and the mathematical method to check and correct. He did not use them to extend introspection, to liberate himself from it, but to tie himself to it. In most of Wundt’s investigations introspection was essentially superfluous. It was only necessary to single out the unsuccessful experiments. In principle it is totally unnecessary in Kornilov’s theory. But psychology must still create its thermometer. Korniov’s research indicates the path.
We may summarize the conclusions from our investigation of the narrow sensualist dogma by again referring to Engels’ words about the activity of the eye which in combination with thinking helps us to discover that ants see what is invisible to us.

Psychology has too long striven for experience instead of knowledge. In the present example it preferred to share with the ants their visual experience of the sensation of chemical beams rather than to understand their vision scientifically.

As to the methodological spine that is supporting them there are two scientific systems. Methodology is always like the backbone, the skeleton in the animal’s organism. Very primitive animals, like the snail and the tortoise, carry their skeleton on the outside and they can, like an oyster, be separated from their skeleton. What is left is a poorly differentiated fleshy part. Higher animals carry their skeleton inside and make it into the internal support, the bone of each of their movements. In psychology as well we must distinguish lower and higher types of methodological organization.

This is the best refutation of the sham empiricism of the natural sciences. It turns out that nothing can be transposed from one theory to another. It would seem that a fact is always a fact. Despite the different points of departure and the different aims one and the same object (a child) and one and the same method (objective observation) should make it possible to transpose the facts of psychology to reflexology. The difference would only be in the interpretation of the same facts. In the end the systems of Ptolemy and Copernicus rested upon the same facts as well. [But] It turns out that facts obtained by means of different principles of knowledge are different facts.

Thus, the debate about the application of the biogenetic principle in psychology is not a debate about facts. The facts are indisputable and there are two groups of them: the recapitulation of the stages the organism goes through in the development of its structure as established by natural science and the indisputable traits of similarity between the phylo- and ontogenesis of the mind. It is particularly important that neither is there any debate about the latter group. Koffka [1925, pp.32], who contests this theory and subjects it to a methodological analysis, resolutely declares that the analogies, from which this false theory proceeds, exist beyond any doubt. The debate concerns the meaning of these analogies and it turns out that it cannot be decided without analyzing the principles of child psychology, without having a general idea of childhood, a conception of the meaning and the biological sense of childhood, a certain theory of child development. It is quite easy to find analogies. The question is how to search for them. Similar analogies may be found in the behavior of adults as well.

Two typical mistakes are possible here: one is made by Hall, Thorndike and Groos have brilliantly exposed it in critical analyses. The latter [Groos, 1904/1921, p. 7] justly claims that the purpose of any comparison and the task of comparative science is not only to distinguish similar traits, but even more to search for the differences within the similarity. Comparative psychology, consequently, must not merely understand man as an animal, but much more as a non-animal.

The straightforward application of the principle led to a ubiquitous search for similarity. A correct method and reliably established facts led to monstrously strained interpretations and distorted facts when applied uncritically. Children’s games have indeed traditionally preserved many echoes of the remote past (the play with bows, round dances). For Hall this is the repetition and expression in innocent form of the animal and pre-historic stages of development. Groos considers this to show a remarkable lack of critical judgment. The fear of cats and dogs would be a remnant of the time when these animals were still wild. Water would attract children because we developed from aquatic animals. The automatic movements of the infant’s arms would be a remnant of the movements of our ancestors who swam in the water, etc..

The mistake resides, consequentiy, in the interpretation of the child’s whole behavior as a recapitulation and in the absence of any principle to verify the analogy and to select the facts which must and must not be interpreted. It is precisely the play of animals which cannot be explained in
this way. “Can Hall’s theory explain the play of the young tiger with its victim?” – asks Groos [1904/1921, p. 73]. It is clear that this play cannot be understood as a recapitulation of past phylogenetic development. It foreshadows the future activity of the tiger and not a repetition of his past development. It must be explained and understood in relation to the tiger’s future, in the light of which it gets its meaning, and not in the light of the past of his species. The past of the species comes out in a totally different sense: through the individual’s future which it predetermines, but not directly and not in the sense of a repetition.

What are the facts? This quasi-biological theory appears to be untenable precisely in biological terms, precisely in comparison with the nearest homogeneous analogue in the series of homogeneous phenomena in other stages of evolution. When we compare the play of a child with the play of a tiger, i.e., a higher mammal, and consider not only the similarity, but the difference as well, we will lay bare their common biological essence which resides exactly in their difference (the tiger plays the chase of tigers; the child that he is a grown-up; both practice necessary functions for their life to come – Groos’ theory). But despite all the seeming similarity in the comparison of heterogeneous phenomena (play with water – aquatic life of the amphibian – man) the theory is biologically meaningless.

Thorndike [1906] adds to this devastating argument a remark about the different order of the same biological principles in onto- and phylogencsis. Thus, consciousness appears very early in ontogenesis and very late in phylogenesis. The sexual drive, on the other hand, appears very early in phylogenesis and very late in ontogenesis. Stern [1927, pp. 266-267], using similar considerations, criticizes the same theory in its application to play.

Blonsky (1921) makes another kind of mistake. He defends – and very convincingly – this law for embryonic development from the viewpoint of biomechanics and shows that it would be miraculous if it did not exist. The author points out the hypothetical nature of the considerations (“not very conclusive”) leading to this contention (“it may be like this”), i.e., he gives arguments for the methodological possibility of a working hypothesis, but then, instead of proceeding to the investigation and verification of the hypothesis, follows in Hall’s footsteps and begins to explain the child’s behavior on the basis of very intelligible analogies: he does not view the climbing of trees by children as a recapitulation of the life of apes, but of primitive people who lived amidst rocks and ice; the tearing off of wallpaper is an atavism of the tearing off of the bark of trees etc. What is most remarkable of all is that the error leads Blonsky to the same conclusion as Hall: to the negation of play. Groos and Stern have shown that exactly where it is easiest to find analogies between onto- and phylogenesis is this theory untenable. And neither does Blonsky, as if illustrating the irresistible force of the methodological laws of scientific knowledge, search for new terms. He sees no need to attach a “new term” (play) to the child’s activity. This means that on his methodological path he first lost its meaning and then – with creditable consistency – refrained from the term that expresses this meaning. Indeed, if the activity, the child’s behavior, is an atavism, then the term “play” is out of place. This activity has nothing in common with the play of the tiger as Groos demonstrated. And we must translate Blonsky’s declaration “I don’t like this term” in methodological terms as “I lost the understanding and meaning of this concept.”

Only in this way, by following each principle to its ultimate copclusions, by taking each concept in the extreme form toward which it strives, by investigating each line of thinking to the very end, at times completing it for the author, can we determine the methodological nature of the phenomenon under investigation. That is why a concept that is used deliberately, not blindly, in the science for which it was created, where it originated, developed, and was carried to its ultimate expression, is blind, leads nowhere when transposed to another science. Such blind transpositions of the biogenetic principle, the experiment, the mathematical method from the natural sciences, created the appearance of science in psychology which in reality concealed a total impotence in the face of the studied facts.

But to complete the sketch of the circle described by the meaning of a principle introduced into a
If one would like to get an objective and clear idea of the contemporary state of psychology and the dimensions of its crisis, it would suffice to study the psychological language, i.e., the nomenclature and terminology, the dictionary and syntax of the psychologist. Language, scientific language in particular, is a tool of thought, an instrument of analysis, and it suffices to examine which instruments a science utilizes to understand the character of its operations. The highly developed and exact language of contemporary physics, chemistry, and physiology, not to speak of
mathematics where it plays an extraordinary role, was developed and perfected during the
development of science and far from spontaneously, but deliberately under the influence of
tradition, critique, and the direct terminological creativity of scientific societies and congresses. The
psychological language of contemporaneity is first of all terminologically insufficient: this means
that psychology does not yet have its own language. In its dictionary you will find a conglomerate
of words of three kinds: (1) the words of everyday language, which are vague, ambiguous, and
adapted to practical life (Lazursky levelled this criticism against faculty psychology; I succeeded in
showing that it is more true of the language of empirical psychology and of Lazursky himself in
particular; see Preface to Lazursky in this volume). Suffice it to remember the touchstone of all
translators—the visual sense (i.e., sensation) to realize the whole metaphorical nature and
inexactness of the practical language of daily life; (2) the words of philosophical language. They too
pollute the language of psychologists, as they have lost the link with their previous meaning, are
ambiguous as a result of the struggle between the various philosophical schools, and are abstract to
a maximal degree. Lalande (1923) views this as the main source of the vagueness and lack of clarity
in psychology. The tropes of this language favor vagueness of thought. These metaphors are
valuable as illustrations, but dangerous as formulas. It also leads to personifications through the
ending -ism, of mental facts, functions, systems and theories, between which small mythological
dramas are invented; (3) finally, the words and ways of speaking taken from the natural sciences
which are used in a figurative sense bluntly serve deception. When the psychologist discusses
energy, force, and even intensity, or when he speaks of excitation etc., he always covers a non-
scientific concept with a scientific word and thereby either deceives, or once again underlines the
whole indeterminate nature of the concept indicated by the exact foreign term.

Lalande [1923, p. 52] correctly remarks that the obscurity of language depends as much upon its
syntax as upon its dictionary. In the construction of the psychological phrase we meet no fewer
mythological dramas than in the lexicon. I want to add that the style, the manner of expression of a
science is no less important. In a word, all elements, all functions of a language show the traces of
the age of the science that makes use of them, and determine the character of its workings.

It would be mistaken to think that psychologists have not noticed the mixed character, the
inaccuracy, and the mythological nature of their language. There is hardly any author who in one
way or another has not dwelt upon the problem of terminology. Indeed, psychologists have
pretended to describe, analyze and study very subtle things, full of nuances, they have attempted to
convey the unique mental experience, the facts sui generis which occur only once, when science
wished to convey the experience itself, i.e., when the task of its language was equal to that of the
word of the artist. For this reason psychologists recommended that psychology be learned from the
great novelists, spoke in the language of the impressionistic fine literature themselves, and even the
best, most brilliant stylists among the psychologists were unable to create an exact language and
wrote in a figurative-expressive way. They suggested, sketched, described, but did not record. This
was the case for James, Lipps, and Binet.

The 6th International Congress of psychologists in Geneva (1909) put this question on its agenda
and published two reports—by Baldwin and Claparède—on this topic, but did no more than
establishing rules for linguistical possibilities, although Claparède tried to give a definition of 40
laboratory terms. Baldwin’s dictionary in England and the technical and critical dictionary of
philosophy in France have accomplished much, but despite this the situation becomes worse every
year and to read a new book with the help of the above-mentioned dictionaries is impossible. The
encyclopedia from which I take this information views it as one of its tasks to introduce solidity and
stability into the terminology, but gives occasion to new instability as it introduces a new system of
terms [Dumas, 1923]. [36] The language reveals as it were the molecular changes that the science
goes through. It reflects the internal processes that take shape—the tendencies of development,
reform, and growth. We may assume, therefore, that the troubled condition of the language reflects
a troubled condition of the science. We will not deal any further with the essence of this relation.
We will take it as our point of departure for the analysis of the contemporary molecular
terminological changes in psychology. Perhaps, we will be able to read in them the present and future fate of the science. Let us first of all begin with those who are tempted to deny any fundamental importance to the language of science and view such debates as scholastic logomachy. Thus, Chelpanov (1925) considers the attempt to replace the subjective terminology by an objective one as a ridiculous pretension, utter nonsense. The zoopsychologists (Beer, Bethe, Von Uexküll) have used “photoreceptor” instead of “eye”, “stiboreceptor” instead of “nose,” “receptor” instead of “sense organ” etc. (Chelpanov, 1925). [37]

Chelpanov is tempted to reduce the whole reform carried out by behaviorism to a play of words. He assumes that in Watson’s writings the word “sensation” or “idea” is replaced by the word “reaction.” In order to show the reader the difference between ordinary psychology and the psychology of the behaviorist, Chelpanov (1925) gives examples of the new way of expressing things:

In ordinary psychology it is said: ‘When someone’s optical nerve is stimulated by a mixture of complementary light waves, he will become conscious of the white color.’ According to Watson in this case we must say: ‘He reacts to it as if it were a white color.’

The triumphant conclusion of the author is that the matter is not changed by the words used. The whole difference is in the words. Is this really true? For a psychologist of Chelpanov’s kind it is definitively true. Who does not investigate nor discover anything new cannot understand why researchers introduce new terms for new phenomena. Who has no view of his own about the phenomena and accepts indifferently both Spinoza, Husserl, Marx, and Plato, for such a person a fundamental change of words is an empty pretension. Who eclectically—in the order of appearance—assimilates all Western European schools, currents and directions, is in need of a vague, undefined, levelling, everyday language—“as is spoken in ordinary psychology.” For a person who conceives of psychology only in the form of a textbook it is a matter of life and death to preserve everyday language, and as lots of empiricist psychologists belong to this type, they speak in this mixed and motley jargon, in which the consciousness of the white color is simply a fact which is in no need of any further critique.

For Chelpanov it is a caprice, an eccentricity. But why is this eccentricity so regular? Doesn’t it contain something essential? Watson, Pavlov, Bekhterev, Kornilov, Bethe and Von Uexküll (Chelpanov’s list may be continued ad libitum from any area of science), Kohler, Koffka and others and still others demonstrated this eccentricity. This means that there is some objective necessity in the tendency to introduce new terminology.

We can say in advance that the word that refers to a fact at the same time provides a philosophy of that fact, its theory, its system. When I say: “the consciousness of the color” I have scientific associations of a certain kind, the fact is included in a certain series of phenomena, I attach a certain meaning to the fact. When I say: “the reaction to white” everything is wholly different. But Chelpanov is only pretending that it is a matter of words. For him the thesis “a reform of terminology is not needed” forms the conclusion from the thesis “a reform of psychology is not needed.” Never mind that Chelpanov gets caught in contradictions: on the one hand Watson is only changing words; on the other hand behaviorism is distorting psychology. It is one of two things: either Watson is playing with words—then behaviorism is a most innocent thing, an amusing joke, as Chelpanov likes to put it when he reassures himself; or behind the change of words is concealed a change of the matter—then the change of words is not all that funny. A revolution always tears off the old names of things—both in politics and in science.

But let us proceed to other authors who do understand the importance of new words. It is clear to them that new facts and a new viewpoint necessitate new words. Such psychologists fall into two groups. Some are pure eclectics, who happily mix the old and new words and view this procedure as some eternal law. Others speak in a mixed language out of necessity. They do not coincide with any of the debating parties and strive for a unified language, for the creation of their own language.
We have seen that such outspoken eclectics as Thorndike equally apply the term “reaction” to temper, dexterity, action, to the objective and the subjective. As he is not capable of solving the question of the nature of the studied facts and the principles of their investigation, he simply deprives both the subjective and the subjective terms of their meaning. “Stimulus-reaction” is for him simply a convenient way to describe the phenomena. Others, such as Pillsbury [1917, pp. 4-14], make eclecticism their principle: the debates about a general method and viewpoint are of interest for the technically-minded psychologist. Sensation and perception he explains in the terms of the structuralists, actions of all kinds in those of the behaviorists. He himself is inclined towards functionalism. The different terms lead to discrepancies, but he prefers the use of the terms of many schools to those of a single specific school. In complete accordance with this he explains the subject matter of psychology with illustrations from everyday life, in vague words, instead of giving formal definitions. Having given the three definitions of psychology as the science of mind, consciousness, or behavior, he concludes that they may very well be neglected in the description of the mental life. It is only natural that terminology leaves our author indifferent as well Koffka (1925) and others try to realize a fundamental synthesis of the old and the new terminology. They understand very well that the word is a theory of the fact it designates and, therefore, they view behind two systems of terms two systems of concepts. Behavior has two aspects–one that must be studied by natural scientific observation and one that must be experienced and to these correspond functional and descriptive concepts. The functional objective concepts and terms belong to the category of natural scientific ones, the phenomenal descriptive ones are absolutely foreign to it (to behavior). This fact is often obscured by the language which does not always have separate words for this or that kind of concept, as everyday language is not scientific language.

The merit of the Americans is that they have fought against subjective anecdotes in animal psychology. But we will not fear the use of descriptive concepts when describing animal behavior. The Americans have gone too far, they are too objective. What is again highly remarkable: Gestalt theory, which is internally deeply dualistic, reflecting and uniting two contradictory tendencies which, as will be shown below, currently determine the whole crisis and its fate, wishes in principle to preserve this dual language forever, for it proceeds from the dual nature of behavior. However, sciences do not study what is closely related in nature, but what is conceptually homogeneous and similar. How can there be one science about two absolutely different kinds of phenomena, which evidently require two different methods, two different explanatory principles, etc.? After all, the unity of a science is guaranteed by unity of the viewpoint on the subject. How then can we build a science with two viewpoints? Once again a contradiction in terms corresponds to a contradiction in principles.

Matters are slightly different with another group of mainly Russian psychologists, who use various terms but view this as the attribute of a period of transition. This “demi-saison,” as one psychologist calls it, requires clothes that combine the properties of a fur coat and a summer dress, warm and light at the same time. Thus, Blonsky holds that it is not important how we designate the phenomena under study but bow we understand them. We utilize the ordinary vocabulary for our speech but to these ordinary words we attach a content that corresponds to the science of the 20th century. It is not important to avoid the expression “The dog is angry.” What is important is that this phrase is not the explanation, but the problem (Blonsky, 1925). Strictly speaking, this implies a complete condemnation of the old terminology: for there this phrase was the explanation. But this phrase must be formulated in an appropriate way and not with the ordinary vocabulary. This is the main thing required to make it a scientific problem. And those whom Blonsky calls the pedants of terminology appreciate much better than he does that the phrase conceals a content given by the history of science. However, like Blonsky many utilize two languages and do not consider this a question of principle. This is the way Kornilov proceeds, this is what I do, repeating after Pavlov: what does it matter whether I call them mental or higher nervous [processes]? But already these examples show the limits of such a bilingualism. The limits themselves show again most clearly what our whole analysis of the eclectics showed: bilingualism is the external sign of dual thinking.
You may speak in two languages as long as you convey dual things or things in a dual light. Then it really does not matter what you call them.

So, let us summarize. For empiricists it is necessary to have a language that is colloquial, indeterminate, confused, ambiguous, vague, in order that what is said can be reconciled with whatever you like—today with the church fathers, tomorrow with Marx. They need a word that neither provides a clear philosophical qualification of the nature of the phenomenon, nor simply its clear description, because the empiricists have no clear understanding and conception of their subject. The eclectics, both those that are so by principle and those that adhere to eclecticism only for the time being, are in need of two languages as long as they defend an eclectic point of view. But as soon as they leave this viewpoint and attempt to designate and describe a newly discovered fact or explain their own viewpoint on a subject, they lose their indifference to the language or the word. Kornilov (1922), who made a new discovery, is prepared to turn the whole area to which he assigns this phenomenon from a chapter of psychology into an independent science—reactology.

Elsewhere he contrasts the reflex with the reaction and views a fundamental difference between the two terms. They are based on wholly different philosophies and methodologies. Reaction is for him a biological concept and reflex a strictly physiological one. A reflex is only objective, a reaction is subjective objective. This explains why a phenomenon acquires one meaning when we call it a reflex and another when we call it a reaction. Obviously, it makes a difference how we refer to the phenomena and there is a reason for pedantry when it is backed by an investigation or a philosophy. A wrong word implies a wrong understanding. It is not for nothing that Blonsky notices that his work and the outline of psychology by Jameson (1925)—this typical specimen of philistinism and eclecticism in science—overlap. To view the phrase “the dog is angry” as the problem is wrong if only because, as Shchelovanov (1929) justly pointed out, the finding of the term is the end point and not the starting point of the investigation. As soon as one or the other complex of reactions is referred to with some psychological term all further attempts at analysis are finished. If Blonsky would leave his eclectic stand, like Kornilov, and acknowledge the value of investigation or principle, he would find this out. There is not a single psychologist with whom this would not happen. And such an ironic observer of the “terminological revolutions” as Chelpanov suddenly turns out to be an astonishing pedant: he objects to the name “reactology.” With the pedantry of one of Chekhov’s gymnasiu teachers he preaches that this term causes misunderstanding, first etymologically and second theoretically. The author declares with aplomb that etymologically speaking the word is entirely incorrect—we should say “reactiology” [reaktsiologija]. This is of course the summit of linguistic illiteracy and a flagrant violation of all the terminological principles of the 6th Congress on the international (Latin-Greek) basis of terms. Obviously, Korniov did not form his term from the home-bred “reaktsija,” but from reactio and he was perfectly right in doing so. One wonders how Chelpanov would translate “reactiology” into French, German, etc. But this is not what it is all about. It is about something else: Chelpanov declares that this term is inappropriate in Kornilov’s system of psychological views. But let us speak to the point. The important thing is that the meaning of a term is accepted in a system of views. It turns out that even reflexology conceived of in a certain way has its raison d’être.

Let people not think that these trifles have no importance, because they are too obviously confused, contradictory, incorrect, etc. Here there is a difference between the scientific and the practical points of view. Munsterberg explained that the gardener loves his tulips and hates the weeds, but the botanist who describes and explains loves or hates nothing and, from his point of view, cannot love or hate. For the science of man, he says, stupidity is of no less interest than wisdom. It is all indifferent material that merely claims to exist as a link in the chain of phenomena. As a link in the chain of causal phenomena, this fact—that terminology suddenly becomes an urgent question for the eclectic psychologist who does not care about terminology unless it touches his position—is a valuable methodological fact. It is as valuable as the fact that other eclectics following the same path come to the same conclusion as Kornilov: neither the conditional nor the correlative reflexes appear sufficiently clear and understandable. Reactions are the basis of the new psychology, and the
whole psychology developed by Pavlov, Bekhterev and Watson is called neither reflexology nor behaviorism, but ‘psychologie de reaction,’ i.e., reactology. Let the eclectics come to opposite conclusions about a specific thing. They are still related by the method, the process by which they arrive at their conclusions.

We find the same regularity in all reflexologists—both investigators and theoreticians. Watson [1914, p. 9] is convinced that we can write a course in psychology without using the words “consciousness,” “content,” “introspectively verified,” “imagery” etc. And for him this is not a terminological matter, but one of principle: just as the chemist cannot use the language of alchemy nor the astronomer that of the horoscope. He explains this brilliantly with the help of one specific case: he regards the difference between a visual reaction and a visual image as extremely important because behind it lies the difference between a consistent monism and a consistent dualism [1914, pp. 16-20]. A word is for him the tentacle by which philosophy comprehends a fact. Whatever is the value of the countless volumes written in the terms of consciousness, it can only be determined and expressed by translating them into objective language. For according to Watson consciousness and so on are no more than undefined expressions. And the new textbook breaks with the popular theories and terminology. Watson condemns “half-hearted psychology of behavior” (which brings harm to the whole current) claiming that when the theses of the new psychology will not preserve their clarity its framework will be distorted, obscured, and it will lose its genuine meaning. Functional psychology perished from such half-heartedness. If behaviorism has a future then it must break completely with the concept of consciousness. However, thus far it has not been decided whether behaviorism will become the dominating system of psychology or simply remain a methodological approach. And therefore Watson (1926) too often takes the methodology of common sense as the basis of his investigations. In the attempt to liberate himself from philosophy he slips into the viewpoint of the “common man,” understanding by this latter not the basic feature of human practice but the common sense of the average American businessman. In his opinion the common man must welcome behaviorism. Ordinary life has taught him to act that way. Consequently, when dealing with the science of behavior he will not feel a change of method or some change of the subject (ibid.). This viewpoint implies the verdict on all behaviorism. Scientific study absolutely requires a change of the subject (i.e., its treatment in concepts) and the method. But behavior itself is understood by these psychologists in its everyday sense and in their arguments and descriptions there is much of the philistine way of judgment. Therefore, neither radical nor half-hearted behaviorism will ever find—either in style and language, or in principle and method—the boundary between everyday and philistine understanding. Having liberated themselves from the “alchemy” in language, the behaviorists have polluted it with everyday, non-terminological speech. This makes them akin to Chelpanov: the whole difference can be attributed to the life style of the American or Russian philistine. The reproach that the new psychology is a philistine psychology is therefore partially justified.

This vagueness of language in the Americans, which Blonsky considers a lack of pedantry, is viewed by Pavlov [1928/1963, pp. 213-214] as a failing. He views it as a gross defect which prevents the success of the work, but which, I have no doubt, will sooner or later be removed. I refer to the application of psychological concepts and classifications in this essentially objective study of the behavior of animals. Herein lies the cause of the fortuitous and conditional character of their complicated methods, and the fragmentary and unsystematic character of their results, which have no well planned basis to rest on.

One could not express the role and function of language in scientific investigation more clearly. And Pavlov’s entire success is first of all due to the enormous consistency in his language. His investigations led to a theory of higher nervous activity and animal behavior, rather than a chapter on the functioning of the salivary glands, exclusively because he lifted the study of salivary secretion to an enormously high theoretical level and created a transparent system of concepts that lies at the basis of the science. One must marvel at Pavlov’s principled stand in methodological matters. His book introduces us into the laboratory of his investigations and teaches us how to
create a scientific language. At first, what does it matter what we call the phenomenon? But gradually each step is strengthened by a new word, each new principle requires a term. He clarifies the sense and meaning of the use of new terms. The selection of terms and concepts predetermines the outcome of an investigation:

I cannot understand how the non-spatial concepts of contemporary psychology can be fitted into the material structure of the brain [ibid., p. 224].

When Thorndike speaks of a mood reaction and studies it, he creates concepts and laws that lead us away from the brain. To have recourse to such a method Pavlov calls cowardice. Partly out of habit, partly from a “certain anxiety,” be resorted to psychological explanations.

But soon I understood that they were bad servants. For me there arose difficulties when I could see no natural relations between the phenomena. The succor of psychology was only in words (the animal has ‘remembered,’ the animal ‘wished,’ the animal ‘thought’), i.e., it was only a method of indeterminate thinking without a basis in fact (italics mine, L. V.) [ibid., p. 237].

He regards the manner in which psychologists express themselves as an insult against serious thinking.

And when Pavlov introduced in his laboratories a penalty for the use of psychological terms this was no less important and revealing for the history of the theory of the science than the debate about the symbol of faith for the history of religion. Only Chelpanov can laugh about this: the scientist does not fine for [the use of] an incorrect term in a textbook or in the exposition of a subject, but in the laboratory—in the process of the investigation. Obviously, such a fine was imposed for the non-causal, non-spatial, indeterminate, mythological thinking that came with that word and that threatened to blow up the whole cause and to introduce—as in the ease of the Americans—a fragmentary, unsystematic character and to take away the foundations.

Chelpanov (1925) does not suspect at all that new words may be needed in the laboratory, in an investigation, that the sense [and] meaning of an investigation are determined by the words used. He criticizes Pavlov, stating that “inhibition” is a vague, hypothetical expression and that the same must be said of the term “disinhibition.” Admittedly, we don’t know what goes on in the brain during inhibition, but nevertheless it is a brilliant, transparent concept. First of all, it is well defined, i.e., exactly determined in its meaning and boundaries. Secondly, it is honest, i.e., it says no more than is known. Presently the processes of inhibition in the brain are not wholly clear to us, but the word and the concept “inhibition” are wholly clear. Thirdly, it is principled and scientific, i.e., it includes a fact into a system, underpins it with a foundation, explains it hypothetically, but causally. Of course, we have a clearer image of an eye than of an analyzer. Exactly because of this the word “eye” doesn’t mean anything in science. The term “visual analyzer” says both less and more than the word “eye.” Pavlov revealed a new function of the eye, compared it with the function of other organs, connected the whole sensory path from the eye to the cortex, indicated its place in the system of behavior—and all this is expressed by the new term. It is true that we must think of visual sensations when we hear these words, but the genetic origin of a word and its terminological meaning are two absolutely different things. The word contains nothing of sensations; it can be adequately used by a blind person. Those who, following Chelpanov, catch Pavlov making a slip of the tongue, using fragments of a psychological language, and find him guilty of inconsistency, do not understand the heart of the matter. When Pavlov uses [words such as] happiness, attention, idiot (about a dog), this only means that the mechanism of happiness, attention etc. has not yet been studied, that these are the as yet obscure spots of the system; it does not imply a fundamental concession or contradiction.

But all this may seem incorrect as long as we do not take the opposite aspect into account. Of course, terminological consistency may become pedantry, “verbalism,” common place (Bekhterev’s school). When does that occur? When the word is like a label stuck on a finished article and is not born in the research process. Then it does not define, delimit, but introduces vagueness and
shambles in the system of concepts.

Such a work implies the pinning on of new labels which explain absolutely nothing, for it is not
difficult, of course, to invent a whole catalogue of names: the reflex of purpose, the reflex of God,
the reflex of right, the reflex of freedom, etc. A reflex can be found for everything. The problem is
only that we gain nothing but trifles. This does not refute the general rule, but indirectly confirms it:
new words keep pace with new investigations.

Let us summarize. We have seen everywhere that the word, like the sun in a drop of water, fully
reflects the processes and tendencies in the development of a science. A certain fundamental unity
of knowledge in science comes to light which goes from the highest principles to the selection of a
word. What guarantees this unity of the whole scientific system? The fundamental methodological
skeleton. The investigator, insofar as he is not a technician, a registrar, an executor, is always a
philosopher who during the investigation and description is thinking about the phenomena, and his
way of thinking is revealed in the words he uses. A tremendous discipline of thought lies behind
Pavlov’s penalty. A discipline of mind similar to the monastic system which forms the core of the
religious world view is at the core of the scientific conception of the world. He who enters the
laboratory with his own word is deemed to repeat Pavlov’s example. The word is a philosophy of
the fact; it can be its mythology and its scientific theory. When Lichtenberg said: “Es denkt, sollte
man sagen, so wie man sagt: es blitzt,” he was fighting mythology in language. To say “cogito” is
saying too much when it is translated as “I think.” Would the physiologist really agree to say “I
conduct the excitation along my nerve”? To say “I think” or “It comes to my mind” implies two
opposite theories of thinking. Binet’s whole theory of the mental poses requires the first expression,
Freud’s theory the second and Kulpe’s theory now the one, now the other. Hofding [1908, p. 106,
footnote 2] sympathetically cites the physiologist Foster who says that the impressions of an animal
deprived of [one of] its cerebral hemispheres we must “either call sensations, or we must invent an
entirely new word for them,” for we have stumbled upon a new category of facts and must choose a
way to think about it—whether in connection with the old category or in a new fashion.

Among the Russian authors it was Lange (1914, p. 43) who understood the importance of
terminology. Pointing out that there is no shared system in psychology, that the crisis shattered the
whole science, he remarks that

Without fear of exaggeration it can be said that the description of any psychological process
becomes different whether we describe and study it in the categories of the psychological system of
Ebbinghaus or Wundt, Stumpf or Avenarius, Meinong or Binet, James or E. Muller. Of course, the
purely factual aspect must remain the same. However, in science, at least in psychology, to separate
the described fact from its theory, i.e., from those scientific categories by means of which this
description is made, is often very difficult and even impossible, for in psychology (as, by the way,
in physics, according to Duhem) each description is always already a certain theory. ... Factual
investigations, in particular those of an experimental character, seem to the superficial observer to
be free from those fundamental disagreements about basic scientific categories which divide the
different psychological schools.

But the very statement of the questions, the use of one or the other psychological term, always
implies a certain way of understanding them which corresponds to some theory, and consequently
the whole factual result of the investigation stands or falls with the correctness or falsity of the
psychological system. Seemingly very exact investigations, observations, or measurements may,
therefore, prove false, or in any case lose their meaning when the meaning of the basic
psychological theories is changed. Such crises, which destroy or depreciate whole series of facts,
have occurred more than once in science. Lange compares them to an earthquake that arises due to
deep deformations in the depths of the earth. Such was [the ease with] the fall of alchemy. The
dabbling that is now so widespread in science, i.e., the isolation of the technical executive function
of the investigation—chiefly the maintenance of the equipment according to a well-known routine—
from scientific thinking, is noticeable first of all in the breakdown of scientific language. In
principle, all thoughtful psychologists know this perfectly well: in methodological investigations the
terminological problem which requires a most complex analysis instead of a simple note takes the
lion’s share. Rickert regards the creation of unequivocal terminology as the most important task of
psychology which precedes any investigation, for already in primitive description we must select
word meanings which “by generalizing simplify” the immense diversity and plurality of the mental
idea in his example from chemistry:

In organic chemistry the meaning of some body and, consequently, its name are no longer simply
dependent upon its composition, but rather upon its place in the series to which it belongs. That is
why its old name becomes an obstacle for understanding when we find that a body belongs to such
a series and must be replaced by a name that refers to this series (paraffin, etc.).

What has been carried to the rigor of a chemical rule here exists as a general principle in the whole
area of scientific language.

Lange (1914, p. 96) says that

Parallelism is a word which seems innocent at first sight. It conceals, however, a terrible idea—the
idea of the secondary and accidental nature of technique in the world of physical phenomena.

This innocent word has an instructive history. Introduced by Leibniz it was applied to the solution
of the psychophysical problem which goes back to Spinoza, changing its name many times in the
process. Hoffding [1908, p. 91, footnote 1] calls it the identity hypothesis and considers that it is the
only precise and opportune name ... The frequently used term ‘monism’ is etymologically correct
but inconvenient, because it has often been used ... by a more vague and inconsistent conception.
Names such as ‘parallelism’ and ‘dualism’ are inadequate, because they ... smuggle in the idea that
we must conceive of the mental and the bodily as two completely separate series of developments
(almost as a pair of rails) which is exactly what the hypothesis does not assume.

It is Wolff’s hypothesis which must be called dualistic, not Spinoza’s.

Thus, a single hypothesis is now called (1) monism, now (2) dualism, now (3) parallelism, and now
(4) identity. We may add that the circle of Marxists who have revived this hypothesis (as will be
shown below)—Plekanov, and after him Sarabjanov, Frankfurt and others—view it precisely as a
theory of the unity, but not identity of the mental and the physical. How could this happen?
Obviously, the hypothesis itself can be developed on the basis of different more general views and
may acquire different meanings depending on them: some emphasize its dualism, others its monism
etc. Hoffding [1908, p. 96] remarks that it does not exclude a deeper metaphysical hypothesis, in
particular idealism. In order to become a philosophical world view, hypotheses must be elaborated
anew and this new elaboration resides in the emphasis on now this and now that aspect. Very
important is Lange’s (1914, p. 76) reference:

We find psychophysical parallelism in the representatives of the most diverse philosophical
currents—the dualists (the followers of Descartes [37]), the monists (Spinoza), Leibnitz
(metaphysical idealism), the positivists-agnostics (Bain, Spencer [38]), Wundt and Paulsen
(voluntaristic metaphysics).

Hoffding [1908, p. 117] says that the unconscious follows from the hypothesis of identity:

In this case we act like the philologist who via conjectural critique [Konjekturlkritile] supplements
a fragment of an ancient writer. Compared to the physical world the mental world is for us a
fragment; only by means of a hypothesis can we supplement it.

This conclusion follows inevitably from [his] parallelism.
That is why Chelpanov is not all that wrong when he says that before 1922 he called this theory
parallelism and after 1922 materialism. He would be entirely right if his philosophy had not been
adapted to the season in a slightly mechanical fashion. The same goes for the word “function” (I
mean function in the mathematical sense). The formula “consciousness is a function of the brain” points to the theory of parallelism; “physiological sense” leads to materialism. When Kornilov (1925) introduced the concept and the term of a functional relation between the mind and the body, he regarded parallelism as a dualistic hypothesis, but despite this fact and without noticing it himself, he introduced this theory, for although he rejected the concept of function in the physiological sense, its second sense remained.

Thus, we see that, beginning with the broadest hypotheses and ending with the tiniest details in the description of the experiment, the word reflects the general disease of the science. The specifically new result which we get from our analysis of the word is an idea of the molecular character of the processes in science. Each cell of the scientific organism shows the processes of infection and struggle. This gives us a better idea of the character of scientific knowledge. It emerges as a deeply unitary process. Finally, we get an idea of what is healthy or sick in the processes of science. What is true of the word is true of the theory. The word can bring science further, as long as it (1) occupies the territory that was conquered by the investigation, i.e., as long as it corresponds to the objective state of affairs; and is in keeping with the right basic principles, i.e., the most general formulas of this objective world.

We see, therefore, that scientific research is at the same time a study of the fact and—of the methods used to know this fact. In other words, methodological work is done in science itself insofar as this science moves forward and reflects upon its results. The choice of a word is already a methodological process. That methodology and experiment are worked out simultaneously can be seen with particular ease in the case of Pavlov. Thus, science is philosophical down to its ultimate elements, to its words. It is permeated, so to speak, by methodology. This coincides with the Marxist view of philosophy as “the science of sciences,” a synthesis that penetrates science. In this sense Engels [1925/1978, p. 480] remarked that:

Natural scientists may say what they want, but they are ruled by philosophy. ... Not until natural science and the science of history have absorbed dialectics will all the philosophical fuss ... become superfluous and disappear in the positive science.

The experimenters in the natural sciences imagine that they free themselves from philosophy when they ignore it, but they turn out to be slaves of the worst philosophy, which consists of a medley of fragmentary and unsystematic views, since investigators cannot move a single step forwards without thinking, and thinking requires logical definitions. The question of how to deal with methodological problems—“separately from the sciences themselves” or by introducing the methodological investigation in the science itself (in a curriculum or an investigation)—is a matter of pedagogical expediency. Frank (1917/1964, p. 37) is right when he says that in the prefaces and concluding chapters of all books on psychology one is dealing with problems of philosophical psychology. It is one thing, however, to explain a methodology—“to establish an understanding of the methodology” —this is, we repeat, a matter of pedagogical technique. It is another thing to carry out a methodological investigation. This requires special consideration.

Ultimately the scientific word aspires to become a mathematical sign, i.e., a pure term. After all, the mathematical formula is also a series of words, but words which have been very well defined and which are therefore conventional in the highest degree. This is why all knowledge is scientific insofar as it is mathematical (Kant). But the language of empirical psychology is the direct antipode of mathematical language. As has been shown by Locke, Leibnitz and all linguistics, all words of psychology are metaphors taken from the spatial world.

Chapter 10

We proceed to the positive formulations. From the fragmentary analyses of the separate elements of a science we have learned to view it as a complex whole which develops dynamically and lawfully. In which stage of development is our science at this moment, what is the meaning and nature of the
crisis it experiences and what will be its outcome? Let us proceed to the answer to these questions. When one is somewhat acquainted with the methodology (and history) of the sciences, science loses its image of a dead, finished, immobile whole consisting of ready-made statements and becomes a living system which constantly develops and moves forward, and which consists of proven facts, laws, suppositions, structures, and conclusions which are continually being supplemented, criticized, verified, partially rejected, interpreted and organized anew, etc. Science commences to be understood dialectically in its movement, i.e., from the perspective of its dynamics, growth, development, evolution. It is from this point of view that we must evaluate and interpret each stage of development. Thus, the first thing from which we proceed is the acknowledgement of a crisis. What this crisis signifies is the subject of different interpretations. What follows are the most important kinds of interpretation of its meaning.

First of all, there are psychologists who totally deny the existence of a crisis. Chelpanov belongs among them, as do most of the Russian psychologists of the old school in general (only Lange and Frank have seen what is being done in science). In the opinion of such psychologists everything is all right in our science, just as in mineralogy. The crisis came from outside. Some persons ventured to reform our science; the official ideology required its revision. But for neither was there any objective basis in the science itself. It is true, in the debate one had to admit that a scientific reform was undertaken in America as well, but for the reader it was carefully—and perhaps sincerely—concealed that not a single psychologist who left his trace in science managed to avoid the crisis. This first conception is so blind that it is of no further interest to us. It can be fully explained by the fact that psychologists of this type are essentially eclectics and popularizers of other persons' ideas. Not only have they never engaged in the research and philosophy of their science, they have not even critically assessed each new school. They have accepted everything: the WUrzburg school and Husserl's phenomenology, Wundt's and Titchener's experimentalism and Marxism, Spencer and Plato. When we deal with the great revolutions that take place in science, such persons are outside of it not only theoretically. In a practical sense as well they play no role whatever. The empiricists betrayed empirical psychology while defending it. The eclectics assimilated all they could from ideas that were hostile to them. The popularizers can be enemies to no one, they will popularize the psychology that wins. Now Chelpanov is publishing much about Marxism. Soon he will be studying reflexology, and the first textbook of the victorious behaviorism will be compiled by him or a student of his. On the whole they are professors and examiners, organizers and “Kulturträger,” but not a single investigation of any importance has emerged from their school.

Others see the crisis, but evaluate it very subjectively. The crisis has divided psychology into two camps. For them the borderline lies always between the author of a specific view and the rest of the world. But, according to Lotze, even a worm that is half crushed sets off its reflection against the whole world. This is the official viewpoint of militant behaviorism. Watson (1926) thinks that there are two psychologies: a correct one—his own—and an incorrect one. The old one will die of its halfheartedness. The biggest detail he sees is the existence of halfhearted psychologists. The medieval traditions with which Wundt did not want to break wined the psychology without a soul. As you see, everything is simplified to an extreme. There is no particular problem in turning psychology into a natural science. For Watson this coincides with the point of view of the ordinary person, i.e., the methodology of common sense. Bekhterev, on the whole, evaluates the epochs in psychology in the same way: everything before Bekhterev was a mistake, everything after Bekhterev is the truth. Many psychologists assess the crisis likewise. Since it is subjective, it is the easiest initial naive viewpoint. The psychologists whom we examined in the chapter on the unconscious also reason this way: there is empirical psychology, which is permeated by metaphysical idealism—this is a remnant; and there is a genuine methodology of the era, which coincides with Marxism. Everything which is not the first must be the second, as no third possibility is given.

Psychoanalysis is in many respects the opposite of empirical psychology. This already suffices to declare it to be a Marxist system! For these psychologists the crisis coincides with the struggle they
are fighting. There are allies and enemies, other distinctions do not exist.

The objective-empirical diagnoses of the crisis are no better: the severity of the crisis is measured by the number of schools that can be counted. Allport, in counting the currents of American psychology, defended this point of view (counting schools): the school of James and the school of Titchener, behaviorism and psychoanalysis. The units involved in the elaboration of the science are enumerated side by side, but not a single attempt is made to penetrate into the objective meaning of what each school is defending and the dynamic relations between the schools.

The error becomes more serious when one begins to view this situation as a fundamental characteristic of a crisis. Then the boundary between this crisis and any other, between the crisis in psychology and any other science, between every particular disagreement or debate and a crisis, is erased. In a word, one uses an anti-historical and anti-methodological approach which usually leads to absurd results.

Portugalov (1925, p. 12) wishes to argue the incomplete and relative nature of reflexology and not only slips into agnosticism and relativism of the purest order, but ends up with obvious nonsense. “In the chemistry, mechanics, electrophysics and electrophysiology of the brain everything is changing dramatically and nothing has yet been clearly and definitely demonstrated.” Credulous persons believe in natural science, but “when we stay in the realm of medicine, do we really believe, with the hand on our heart, in the unshakable and stable force of natural science . . . and does natural science itself . . . believe in its unshakable, stable, and genuine character?”

There follows an enumeration of the theoretical changes in the natural sciences which are, moreover, lumped together. A sign of equality is put between the lack of solidity or stability of a particular theory and the whole of natural science, and what constitutes the foundation of the truth of natural science—the change of its theories and views—is passed off as the proof of its impotence. That this is agnosticism is perfectly dear, but two aspects deserve to be mentioned in connection with what follows: (1) in the whole chaos of views that serve to picture the natural sciences as lacking a single firm point, it is only . . . subjective child psychology based upon introspection which turns out to be unshakable; (2) amidst all the sciences which demonstrate the unreliability of the natural sciences, geometry is listed alongside optics and bacteriology. It so happens that Euclid said that the sum of the angles of a triangle equals two right angles; Labachevsky dethroned Euclid and demonstrated that the sum of the angles of a triangle is less than two right angles, and Riemann dethroned Lobachevsky and demonstrated that the sum of the angles of a triangle is more than two right angles (ibid., p. 13).

We will still have more than one occasion to meet the analogy between geometry and psychology, and therefore it is worthwhile to memorize this model of a-methodological thinking: (1) geometry is a natural science; (2) Linné, Cuvier, and Darwin “dethroned” each other in the same way as Euclid, Lobachevsky, and Riemann did; finally (3) Lobachevsky dethroned Euclid and demonstrated that...

Kornilov’s (1925) diagnosis is closer to the truth. He views a struggle between two currents—reflexology and empirical psychology and their synthesis—Marxist psychology.

Already Frankfurt (1926) had advanced the opinion that reflexology cannot be viewed as a united whole, that it consists of contradictory tendencies and directions. This is even more true of empirical psychology. A unitary empirical psychology does not exist at all. In general, this simplified schema was created more as a program for operations, critical understanding, and
demarcation than for an analysis of the crisis. For the latter it lacks reference to the causes, tendency, dynamics, and prognosis of the crisis. It is a logical classification of viewpoints present in the USSR and no more than that.

Thus, there has been no theory of the crisis in anything so far discussed, but only subjective communiqués compiled by the staffs of the quarreling parties. Here what is important is to beat the enemy; nobody will waste his time studying him.

Still closer to a theory of the crisis comes Lange (1914, p. 43), who already presents an embryonic description of it. But he has more feeling for than understanding of the crisis. Not even his historical information is to be trusted. For him the crisis commenced with the fall of associationism, i.e., he takes an accidental circumstance for the cause. Having established that “presently some general crisis is taking place” in psychology, he continues: “It consists of the replacement of the previous associationism by a new psychological theory.” This is incorrect if only because associationism never was a generally accepted psychological system which formed the core of our science, but to the present day remains one of the fighting currents which has become much stronger lately and has been revived in reflexology and behaviorism. The psychology of Mill, Bain, and Spencer was never more than what it is now. It has fought faculty psychology (Herbart) like it is doing now. To see the root of the crisis in associationism is to give a very subjective assessment. Lange himself views it as the root of the rejection of the sensualistic doctrine. But today as well Gestalt theory views associationism as the main flaw of all psychology, including the newest.

In reality, it is not the adherents and opponents of this principle who are divided by some basic trait, but groups that evolved upon much more fundamental grounds. Furthermore, it is not entirely correct to reduce it to a struggle between the views of individual psychologists: it is important to lay bare what is shared and what is contradictory behind these various opinions. Lange’s false understanding of the crisis ruined his own work. In defending the principle of a realistic, biological psychology, he fights Ribot and relies upon Husserl and other extreme idealists, who reject the possibility of psychology as a natural science. But some things, and not the least important ones, he established correctly. These are his correct propositions:

(1) There is no generally accepted system of our science. Each of the expositions of psychology by eminent authors is based upon an entirely different system. All basic concepts and categories are interpreted in various ways. The crisis touches upon the very foundations of the science.

(2) The crisis is destructive, but wholesome. It reveals the growth of the science, its enrichment, its force, not its impotence or bankruptcy. The serious nature of the crisis is caused by the fact that the territory of psychology lies between sociology and biology, between which Kant wanted to divide it.

(3) Not a single psychological work is possible without first establishing the basic principles of this science. One should lay the foundations before starting to build.

(4) Finally, the common goal is to elaborate a new theory—a “renewed system of the science.” However, Lange’s understanding of this goal is entirely incorrect. For him it is “the critical evaluation of all contemporary currents and the attempt to reconcile them” (Lange, 1914, p. 43). And he tried to reconcile what cannot be reconciled: Husserl and biological psychology; together with James he attacked Spencer and with Dilthey be renounced biology. For him the idea of a possible reconciliation followed from the idea that “a revolution took place” “against associationism and physiological psychology” (ibid., p. 47) and that all new currents are connected by a common starting point and goal. That is why he gives a global characteristic of the crisis as an earthquake, a swampy area, etc. For him “a period of chaos has commenced” and the task is reduced to the “critique and logical elaboration” of the various opinions engendered by a common cause. This is a picture of the crisis as it was sketched by the participants in the struggle of the 1870s. Lange’s personal attempt is the best evidence for the struggle between the real operative forces which determine the crisis. He regards the combination of subjective and objective psychology as a necessary postulate of psychology, rather than as a topic of discussion and a
problem. As a result he introduces this dualism into his whole system. By contrasting his realistic or biological understanding of the mind with Natorp’s [1904] idealistic conception, he in fact accepts the existence of two psychologies, as we will see below.

But the most curious thing is that Ebbinghaus, whom Lange considers to be an associationist, i.e., a pre-critical psychologist, defines the crisis more correctly. In his opinion the relative imperfection of psychology is evident from the fact that the debates concerning almost all of the most general of its questions have never come to a halt. In other sciences there is unanimity about all the ultimate principles or the basic views which must be at the basis of investigation, and if a change takes place it does not have the character of a crisis. Agreement is soon reestablished. In psychology things are entirely different, in Ebbinghaus’ [1902, p. 9] opinion. Here these basic views are constantly subjected to vivid doubt, are constantly being contested.

Ebbinghaus considers the disagreement to be a chronic phenomenon. Psychology lacks clear, reliable foundations. And in 1874 the same Brentano, with whose name Lange would have the crisis start, demanded that instead of the many psychologies, one psychology should be created. Obviously, already at that time there existed not only many currents instead of a single system, but many psychologies. Today as well this is a most accurate diagnosis of the crisis. Now, too, methodologists claim that we are at the same point as Brentano was [Binswanger, 1922, p. 6]. This means that what takes place in psychology is not a struggle of views which may be reconciled and which are united by a common enemy and purpose. It is not even a struggle between currents or directions within a single science, but a struggle between different sciences. There are many psychologies—this means that it is different, mutually exclusive and really existing types of science that are fighting. Psychoanalysis, intentional psychology,49 reflexology—all these are different types of science, separate disciplines which tend to turn into a general psychology, i.e., to the subordination and exclusion of the other disciplines. We have seen both the meaning and the objective features of this tendency toward a general science. There can be no bigger mistake than to take this struggle for a struggle of views. Binswanger (1922, p. 6) begins by mentioning Brentano’s demand and Windelband’s remark that with each representative psychology begins anew. The cause of this he sees neither in a lack of factual material, which has been gathered in abundance, nor in the absence of philosophical-methodological principles, of which we also have enough, but in the lack of cooperation between philosophers and empiricists in psychology: “There is hardly a single science where theorists and practitioners took such diverse paths.” Psychology lacks a methodology—this is the author’s conclusion, and the main thing is that we cannot create a methodology now. We cannot say that general psychology has already fulfilled its duties as a branch of methodology. On the contrary, wherever you look, imperfection, uncertainty, doubt, contradiction reign. We can only talk of the problems of general psychology and not even of that, but of an introduction to the problems of general psychology [ibid., p. 5]. Binswanger sees in psychologists a “courage and will toward (the creation of a new) psychology.” In order to accomplish this they must break with the prejudices of centuries, and this shows one thing: that to this day, the general psychology has not been created. We must not ask, with Bergson, what would have happened if Kepler, Galileo, and Newton had been psychologists, but what can still happen despite the fact that they were mathematicians [ibid., p. 21].

Thus, it may seem that the chaos in psychology is entirely natural and that the meaning of the crisis which psychology became aware of is as follows: there aist many psychologies which have the tendency to create a single psychology by developing a general psychology. For the latter purpose it is not enough to have a Galileo, i.e., a genius who would create the foundations of the science. This is the general opinion of European methodology as it had evolved toward the end of the nineteenth century. Some, mainly French, authors hold this opinion even today. In Russia, Vagner (1923)—almost the only psychologist who has dealt with methodological questions—has always defended it. He expresses the same opinion on the occasion of his analysis of the Années Psychologiques, i.e., a synopsis of the international literature. This is his conclusion: thus, we have quite a number of psychological schools, but not a unified psychology as an independent area of psychology [sic].
From the fact that it doesn’t exist does not follow that it cannot exist (ibid.). The answer to the question where and how it may be found can only be given by the history of science.

This is how biology developed. In the seventeenth century two naturalists lay the foundation for two areas of zoology: Buffon for the description of animals and their way of life, and Linné for their classification. Gradually, both sections engendered a number of new problems, morphology appeared, anatomy, etc. The investigations were isolated from each other and represented as it were different sciences, which were in no way connected but for the fact that they both studied animals. The different sciences were at enmity, attempted to occupy the prevailing position as the mutual contacts increased and they could not remain apart. The brilliant Lamarck succeeded in integrating the uncoordinated pieces of knowledge into one book, which he called “Philosophy of Zoology.” He united his investigations with those of others, Buffon and Linné included, summarized the results, harmonized them with each other, and created the area of science which freviranus called general biology. A single and abstract science was created from the uncoordinated disciplines, which, since the works of Darwin, could stand on its own feet. It is the opinion of Vagner that what was done with the disciplines of biology before their combination into a general biology or abstract zoology at the beginning of the nineteenth century is now taking place in the field of psychology at the beginning of the twentieth century. This belated synthesis in the form of a general psychology must repeat Lamarck’s synthesis, i.e., it must be based on an analogous principle. Vagner sees more than a simple analogy in this. For him psychology must traverse not a similai but the same path. Biopsychology is part of biology. It is an abstraction of the concrete schools or their synthesis, the achievements of all of these schools form its content. It cannot have, and neither has general biology, its own special method of investigation. Each time it makes use of the method of a science that is its composite part. It takes account of the achievements, verifying them from the point of view of evolutionwy theoty and indicating their corresponding places in the general system (Vagner, 1923). This is the expression of a more or less general opinion.

Some details in Vagner call forth doubt. In his understanding, general psychology (1) now forms a part of biology, is based upon the theory of evolution (its basis) etc. Consequently, it is in no need of its own Lamarck and Darwin, or their discoveries, and can realize its synthesis on the basis of already present principles; (2) now still must develop in the same way general biology developed, which is not included in biology as its part, but exists side by side with it. Only in this way can we understand the analogy, which is possible between two similar independent wholes, but not between the fate of a whole (biology) and its part (psychology).

Vagner’s (ibid., p. 53) statement that biopsychology provides “exactly what Marx requires from psychology” causes another embarrassment. In general it can be said that Vagner’s formal analysis is, evidently, as irreproachably correct as his attempt to solve the essence of the problem, and to outline the content of general psychology is methodologically untenable, even simply underdeveloped (part of biology, Marx). But the latter does not interest us now. Let us turn to the formal analysis. Is it correct that the psychology of our days is going through the same crisis as biology before Lamarck and is heading for the same fate?

To put it this way is to keep silent about the most important and decisive aspect of the crisis and to present the whole picture in a false light. Whether psychology is beading for agreement or rupture, whether a general psychology will develop from the combination or separation of the psychological disciplines, depends on what these disciplines bring with them–parts of the future whole, like systematics, morphology and anatomy, or mutually exclusive principles of knowledge. It also depends on what is the nature of the hostility between the disciplines–whether the contradictions which divide psychology are soluble, or whether they are irreconcilable. And it is precisely this analysis of the specific conditions under which psychology proceeds to the creation of a general science that we do not find in Vagner, Lange and the others. Meanwhile, European methodology has already reached a much higher degree of understanding of the crisis and has shown which and how many psychologies exist and what are the possible outcomes. But before we turn to this point we must first quit radically with the misunderstanding that psychology is following the path biology
already took and in the end will simply be attached to it as its part. To think about it in this way is to fail to see that sociology edged its way between the biology of man and animals and tore psychology into two parts (which led Kant to divide it over two areas). We must develop the theory of the crisis in such a way as to be able to answer this question.

Chapter 11

There is one fact that prevents all investigators from seeing the genuine state of affairs in psychology. This is the empirical character of its constructions. It must be torn off from psychology’s constructions like a pellicle, like the skin of a fruit, in order to see them as they really are. Usually empiricism is taken on trust, without further analysis. Psychology with all its diversity is treated as some fundamental scientific unity with a common basis. All disagreements are viewed as secondary phenomena which take place within this unity. But this is a false idea, an illusion. In reality, empirical psychology as a science of general principle – even one general principle – does not exist, and the attempts to create it have led to the defeat and bankruptcy of the very idea of creating an empirical psychology. The same persons who lump together many psychologies according to some common feature which contrasts with their own, e.g., psychoanalysis, reflexology, behaviorism (consciousness – the unconscious, subjectivism – objectivism, spiritualism – materialism), do not see that within such an empirical psychology the same processes take place which take place between it and a branch that breaks away. They do not see that the development of these branches themselves is subject to more general tendencies which are being operative in and can, in consequence, only be properly understood on the basis of the whole field of science. It is the whole of psychology which should be lumped together. What does the empiricism of contemporary psychology mean? First of all, it is a purely negative concept both according to its historical origin and its methodological meaning, and this is not a sufficient basis to unite something. Empirical means first of all “psychology without a soul” (Lange), psychology without any metaphysics (Vvedensky), psychology based on experience (Høffding). It is hardly necessary to explain that these are essentially negative definitions as well. They do not say a word about what psychology is dealing with, what is its positive meaning.

However, the objective meaning of this negative definition is now completely different from what it used to be. Once it concealed nothing – the task of the science was to liberate itself from something, the term was a slogan for that. Now it conceals the positive definitions (which each author introduces in his science) and the genuine processes taking place in the science. It was a temporary slogan and could not be anything else in principle. Now the term “empirical” attached to psychology designates the refusal to select a certain philosophical principle, the refusal to clarify one’s ultimate premises, to become aware of one’s own scientific nature. As such this refusal has its historical meaning and cause – we will dwell upon it below – but about the nature of the science it says essentially nothing, it conceals it. The Kantian thinker Vvedensky (1917, p. 3) expressed this most clearly, but all empiricists subscribe to his formula. Høffding, in particular, says the same. All more or less lean towards one side – Vvedensky provides the ideal balance: “Psychology must formulate all its conclusions in such a way that they will be equally acceptable and equally binding for both materialism, spiritualism, and psychophysical monism.”

From this formula alone it is evident that empiricism formulates its tasks in such a way as to reveal their impossibility. Indeed, on the basis of empiricism, i.e., completely discarding basic premises, no scientific knowledge whatever is logically and historically possible. Natural science, which psychology wishes to liken through this definition, was by its nature, its undistorted essence, always spontaneously materialistic. All psychologists agree that natural science, like, of course, all human praxis, does not solve the problem of the essence of matter and mind, but starts from a certain solution to it, namely the assumption of an objective reality which exists outside of us, in conformity with certain laws, and which can be known. And this is, as Lenin has frequently pointed out, the very essence of materialism. The existence of natural science qua science is due to the
ability to distinguish in our experience between what exists objectively and independently and what exists subjectively. This is not at variance with the different philosophical interpretations or whole schools in natural science which think idealistically. Natural science qua science is in itself, and independently from its proponents, materialistic. Psychology proceeded as spontaneously, despite the different ideas of its proponents, from an idealistic conception.

In reality, there is not a single empirical system of psychology. All transcend the boundaries of empiricism and this we can understand as follows: from a purely negative idea one can deduce nothing. Nothing can be born from “abstinence,” as Vvedensky has it. In reality, all the systems were rooted in metaphysics and their conclusions were overstated. First Vvedensky himself with his theory of solipsism, i.e., an extreme manifestation of idealism.

Whereas psychoanalysis openly speaks about metapsychology, each psychology without a soul concealed its soul, the psychology without any metaphysics – its metaphysics. The psychology based on experience included what was not based on experience. In short, each psychology had its metapsychology. It might not consciously realize it, but this made no difference. Chelpanov (1924), who more than anyone else in the current debate seeks shelter under the word “empirical” and wants to demarcate his science from the field of philosophy, finds, however, that it must have its philosophical “superstructure” and “substructure.” It turns out that there are philosophical concepts which must be examined before one turns to the study of psychology and a study which prepares psychology he calls the substructure. This does not prevent him from claiming on the next page that psychology must be freed from all philosophy. However, in the conclusion he once more acknowledges that it is precisely the methodological problems which are the most acute problems of psychology.

It would be wrong to think that from the concept of empirical psychology we can learn nothing but negative characteristics. It also points to positive processes which take place in our science and which are concealed by this name. With the word “empirical” psychology wants to join the natural sciences. Here all agree. But it is a very specific concept and we must examine what it designates when applied to psychology. In his preface to the encyclopedia, Ribot [1923, p. ix] says (heroically trying to accomplish the agreement and unity of which Lange and Vaguer spoke and in so doing showing its impossibility) that psychology forms part of biology, that it is neither materialistic nor spiritualistic, else it would lose all right to be called a science. In what, then, does it differ from other parts of biology? Only in that it deals with phenomena which are ‘spirituels’ and not physical.

What a trifle! Psychology wanted to be a natural science, but one that would deal with things of a very different nature from those natural science is dealing with. But doesn’t the nature of the phenomena studied determine the character of the science? Are history, logic, geometry, and history of the theater really possible as natural sciences? And Chelpanov, who insists that psychology should be as empirical as physics, mineralogy etc., naturally does not join Pavlov but immediately starts to vociferate when the attempt is made to realize psychology as a genuine natural science. What is he hushing up in his comparison? He wants psychology to be a natural science about (1) phenomena which are completely different from physical phenomena, and (2) which are conceived in a way that is completely different from the way the objects of the natural sciences are investigated. One may ask what the natural sciences and psychology can have in common if the subject matter and the method of acquiring knowledge are different. And Vvedensky (1917, p. 3) says, after he has explained the meaning of the empirical character of psychology: “Therefore, contemporary psychology often characterizes itself as a natural science about mental phenomena or a natural history of mental phenomena.” But this means that psychology wants to be a natural science about unnatural phenomena. It is connected with the natural sciences by a purely negative feature – the rejection of metaphysics – and not by a single positive one.

James explained the matter brilliantly. Psychology is to be treated as a natural science – that was his main thesis. But no one did as much as James to prove that the mental is “not natural scientific.” He explains that all the natural sciences accept some assumptions on faith – natural science proceeds
from the materialistic assumption, in spite of the fact that further reflection leads to idealism. Psychology does the same – it accepts other assumptions. Consequently, it is similar to natural science only in that it uncritically accepts some assumptions; the assumptions themselves are contrary [see pp. 9 – 10 of Burkhardt, 1984].

According to Ribot, this tendency is the main trait of the psychology of the 19th century. Apart from this he mentions the attempts to give psychology its own principle and method (which it was denied by Comte) and to put it in the same relation to biology as biology occupies with respect to physics. But in fact the author acknowledges that what is called psychology consists of several categories of investigations which differ according to their goal and method. And when the authors, in spite of this, attempted to beget a system of psychology and included Pavlov and Bergson, they demonstrated that this task cannot be realized. And in his conclusion Dumas [1924, p. 1121] formulates that the unity of the 25 authors consisted in the rejection of ontological speculation.

It is easy to guess what such a viewpoint leads to: the rejection of ontological speculations, empirism, when it is consistent, leads to the rejection of methodologically constructive principles in the creation of a system, to eclecticism; insofar as it is inconsistent, it leads to a hidden, uncritical, vague methodology. Both possibilities have been brilliantly demonstrated by the French authors. For them Pavlov’s psychology of reactions is just as acceptable as introspective psychology if only they are in different chapters of the book. In their manner of describing the facts and stating the problems, even in their vocabulary, the authors of the book show tendencies of associationism, rationalism, Bergsonism, and synthesis. It is further explained that Bergson’s conception is applied in some chapters, the language of associationism and atomism in others, behaviorism in still others, etc. The “L’Étaité” wants to be impartial, objective, and complete. If it has not always been successful, Dumas [1924, p. 1156] concludes, at least the difference of opinion testifies to intellectual activity and ultimately in that sense it represents its time and country. We couldn’t agree more.

This disagreement – we have seen how far it goes – only convinces us of the fact that an impartial psychology is impossible today, leaving aside the fatal dualism of the “élaité de psychologie” for which psychology is now part of biology, now stands to it as biology itself stands to physics.

Thus, the concept of empirical psychology contains an insoluble methodological contradiction. It is a natural science about unnatural things, a tendency to develop with the methods of natural science, i.e., proceeding from totally opposite premises, a system of knowledge which is contrary to them. This had a fatal influence upon the methodological construction of empirical psychology and broke its back.

Two psychologies exist – a natural scientific, materialistic one and a spiritualistic one. This thesis expresses the meaning of the crisis more correctly than the thesis about the existence of many psychologies. For psychologies we have two, i.e., two different, irreconcilable types of science, two fundamentally different constructions of systems of knowledge. All the rest is a difference in views, schools, hypotheses: individual, very complex, confused, mixed, blind, chaotic combinations which are at times very difficult to understand. But the real struggle only takes place between two tendencies which lie and operate behind all the struggling currents.

That this is so, that two psychologies, and not many psychologies, make up the meaning of the crisis, that all the rest is a struggle within each of these two psychologies, a struggle which has quite another meaning and operational field, that the creation of a general psychology is not a matter of agreement, but of a rupture – all this methodology realized long ago and nobody contests it. (The difference of this thesis from Kornilov’s three directions resides in the whole range of the meaning of the crisis: (1) the concepts of materialistic psychology and reflexology do not coincide (as he says); (2) the concepts of empirical and idealistic psychology do not coincide (as he says), (3) our evaluation of the role of Marxist psychology differs.) Finally, here we are dealing with two tendencies which show up in the struggle between the multitude of concrete currents and within them. Nobody contests that the general psychology will not be a third psychology added to the two
struggling parties, but one of them.

That the concept of empiricism contains a methodological conflict which a self-reflective theory must solve in order to make investigation possible – this idea was made well known by Munsterberg [1920]. In his capital methodological work he declared that this book does not conceal the fact that it wants to be a militant book, it defends idealism against naturalism. It wants to guarantee an unlimited right for idealism in psychology. He lays the theoretical epistemological foundations of empirical psychology and declares that this is the most important thing the psychology of our day needs. Its main concepts have been gathered haphazardly, its logical means of acquiring knowledge have been left to the instinct. Münsterberg’s theme is the synthesis of Fichte’s ethical idealism with the physiological psychology of our day, for the victory of idealism does not reside in its dissociating itself from empirical investigation, but in finding a place for it in its own area. Munsterberg showed that naturalism and idealism are irreconcilable, that is why he talks about a book of militant idealism, says of general psychology that it is bravery and a risk – and not about agreement and unification. And Munsterberg [ibid., p. 10] openly advanced the idea of the existence of two sciences, arguing that psychology finds itself in the strange position that we know incomparably more about psychological facts than we ever did, but much less about the question as to what psychology actually is.

The unity of external methods cannot conceal from us that the different psychologists are talking about a totally different psychology. This internal disturbance can only be understood and overcome in the following way. The psychology of our day is struggling with the prejudice that only one type of psychology exists. ... The concept of psychology involves two totally different scientific tasks, which must be distinguished in principle and for which we can best use special designations since, in reality, there are two kinds of psychology [ibid., p. 10].

In contemporary science all sorts of forms and types of mixing two sciences into a seeming unity are represented. What these sciences have in common is their object, but this does not say anything about these sciences themselves. Geology, geography, and agronomics all study the earth, but their construction, their principle of scientific knowledge differs. We may through description change the mind into a chain of causes and actions and may picture it as a combination of elements – objectively and subjectively. If we carry both conceptions to the extreme and give them a scientific form we will get two “fundamentally different theoretical disciplines One is causal, the other is teleological and intentional psychology” [ibid., pp. 12-13].

The existence of two psychologies is so obvious that it is accepted by all. The disagreement is only about the precise definition of each science. Some emphasize some nuances, others emphasize others. It would be very interesting to follow all these oscillations, because each of them testifies to some objective tendency, to a striving toward one or the other pole, and the scope, the range of contradictions shows that both types of science, like two butterflies in one cocoon, still exist in the form of as yet undifferentiated tendencies.

But now we are not interested in the contradictions, but in the common factor that lies behind them. We are confronted with two questions: what is the common nature of both sciences and what are the causes which have led to the bifurcation of empiricism into naturalism and idealism?

All agree that precisely these two elements lie at the basis of the two sciences, that, consequently, one is natural scientific psychology, and the other is idealistic psychology, whatever the different authors may call them. Following Munsterberg all view the difference not in the material or subject matter, but in the way of acquiring knowledge, in the principle. The question is whether to understand the phenomena in terms of causality, in connection with and having fundamentally the same meaning as all other phenomena, or intentionally, as spiritual activity, which is oriented towards a goal and exempt from all material connections. Dilthey [1894/1977, pp. 37-41], who calls these sciences explanatory and descriptive psychology, traces the bifurcation to Wolff, who divided psychology into rational and empirical psychology, i.e., to the very origin of empirical psychology.
He shows that the division has always been present during the whole course of development of the science and again became explicit in the school of Herbart (1849) and in the works of Waitz. The method of explanatory psychology is identical to that of natural science. Its postulate – there is not a single mental phenomenon without a physical one – leads to its bankruptcy as an independent science and its affairs are transferred into the hands of physiology (ibid.). Descriptive and explanatory psychology do not have the same meaning as systematics and explanation – its two basic parts according to Binswanger (1922) as well – have in the natural sciences.

Contemporary psychology – this doctrine of a soul without a soul – is intrinsically contradictory, is divided into two parts. Descriptive psychology does not seek explanation, but description and understanding. What the poets, Shakespeare in particular, presented in images, it makes the subject of analysis in concepts. Explanatory, natural scientific psychology cannot lie at the basis of a science about the mind, it develops a deterministic criminal law, does not leave any room for freedom, cannot be reconciled with the problem of culture. In contrast, descriptive psychology will become the foundation of the human studies, as mathematics is that of the natural sciences [Dilthey, 1894/1977, p. 74].

Stout [1909, pp. 2-6] openly refuses to call analytic psychology a physical science. It is a positive science in the sense that it investigates matter of fact, reality, what is and is not a norm, not what ought to be. It stands next to mathematics, the natural sciences, theory of knowledge. But it is not a physical science. Between the mental and the physical there is such a gulf that there is no means of tracing their connections. No science of matter stands to psychology in a relation analogous to that in which chemistry and physics stand to biology, i.e., in a relation of more general to more special, but in principle homogeneous, principles. Binswanger [1922, p. 22] divides all problems of methodology into those due to a natural scientific and those due to a non-natural scientific concept of the mind. He openly and clearly explains that there are two radically different psychologies. Referring to Sigwart he calls the struggle against natural psychology the source of the split. This leads us to the phenomenology of experiencing, the basis of Husserl’s pure logic and empirical, but non-natural scientific psychology (Pfander Jaspers).

Bleuler defends the opposite position. He rejects Wundt’s opinion that psychology is not a natural science and, following Rickert, he calls it a generalizing psychology, although he has in mind what Dilthey called explanatory or constructive psychology.

We will not thoroughly examine the question as to how psychology as a natural science is possible and the concepts by means of which it is constructed – all this belongs to the debate within one psychology and it forms the subject of the positive exposition in the next part of our work. What is more, we also leave open another question – whether psychology really is a natural science in the exact sense of the word. Following the European authors we use this word to designate the materialistic nature of this kind of knowledge as clearly as possible. Insofar as Western European psychology did not know or hardly knew the problems of social psychology, this kind of knowledge was thought to coincide with natural science. But to demonstrate that psychology is possible as a materialistic science is still a special and very deep problem, which does not, however, belong to the problem of the meaning of the crisis as a whole.

Almost all Russian authors who have written anything of importance about psychology accept the division – from hearsay, of course – which shows the extent to which these ideas are generally accepted in European psychology. Lange (1914), who mentions the disagreement between Windelband and Rickert on the one hand (who regard psychology as a natural science) and Wundt and Dilthey on the other, is inclined with the latter authors to distinguish two sciences. It is remarkable that he criticizes Natorp as an exponent of the idealistic conception of psychology and contrasts him with a realistic or biological understanding. However, according to Munsterberg, Natorp has from the very beginning demanded the same thing he did, i.e., a subjectivating and an objectivating science of the mind, i.e., two sciences.
Lange merged both viewpoints into a single postulate and expounded both irreconcilable tendencies in his book, considering that the meaning of the crisis resides in the struggle with associationism. He explains Dilthey and Munsterberg with real sympathy and states that “two different psychologies resulted.” Like Janus, psychology showed two different faces: one turned to physiology and natural science, the other to the sciences of the spirit, history, sociology; one science about causal effects, the other about values (ibid., p. 63). It would seem that what remains is to opt for one of the two, but Lange unites them.

Chelpanov proceeded in the same way. In his current polemics he implores us to believe him that psychology is a materialistic science, refers to James as his witness and does not with a single word mention that in the Russian literature the idea of two sciences belongs to him. This deserves further reflection.

Following Dilthey, Stout, Meinong, and Husserl he explains the idea of the analytic method. Whereas the inductive method is distinctive of natural scientific psychology, descriptive psychology is characterized by the analytic method which leads to the knowledge of a priori ideas. Analytic psychology is the basic psychology. It must precede the development of child psychology, zoopsychology, and objective experimental psychology and provide the foundation for all types of psychological investigation. This does not look like the relation of mineralogy to physics, or like the complete separation of psychology from philosophy and idealism.

To show what kind of jump Chelpanov made in his psychological views since 1922, one must not dwell upon his general philosophical statements and accidental phrases, but upon his theory of the analytic method. Chelpanov protests against mixing the tasks of explanatory psychology with those of descriptive psychology and explains that they are absolutely contradictory. In order not to leave any doubt about the question as to which psychology he regards as of primary importance, he connects it with Husserl’s phenomenology, with his theory of ideal essences, and explains that Husserl’s eidos or essence is basically equivalent to Plato’s ideas. For Husserl, phenomenology stands to descriptive psychology as mathematics does to physics. Phenomenology and mathematics are, like geometry, sciences about essences, about ideal possibilities; descriptive psychology and physics are about facts. Phenomenology makes explanatory and descriptive psychology possible.

Despite Husserl’s opinion, for Chelpanov phenomenology and analytic psychology partially overlap and the phenomenological method is completely identical with the analytic method. Chelpanov explains Husserl’s refusal to regard eidetic psychology and phenomenology as being identical in the following way. By contemporary psychology he understands only empirical, i.e., inductive psychology, despite the fact that it also contains phenomenological truths. Thus, there is no need to separate phenomenology from psychology. The phenomenological method must be laid at the basis of the objective experimental methods, which Chelpanov timidly defends against Husserl. This is the way it was, this is the way it will be, the author concludes.

How can we square this with his claim that psychology is only empirical, excludes idealism by its very nature and is independent from philosophy? We can summarize. Whatever the division in question is called, whatever shades of meaning in each term are emphasized, the basic essence of the question remains the same and it can be reduced to two propositions.

1. In psychology empiricism indeed proceeded just as spontaneously from idealistic premises as natural science did from materialistic ones, i.e., empirical psychology was idealistic in its foundation.

2. For certain reasons (to be considered below), in the era of the crisis empiricism split into idealistic and materialistic psychology. Munsterberg (1920, p. 14), too, interprets the difference in terminology as unity of meaning. We can speak of causal and intentional psychology, or about the psychology of the spirit and the psychology of consciousness, or about understanding and explanatory psychology. But the only thing of principal importance is that we recognize the dual nature of psychology. Elsewhere Munsterberg [1920, pp. vii-viii] contrasts the psychology of the
contents of consciousness with the psychology of the spirit, the psychology of contents with the psychology of acts, and the psychology of sensations with intentional psychology.

We have basically reached an opinion which established itself in our science long ago: psychology has a deeply dualistic nature which pervades its whole development. We have, thus, arrived at an indisputably historic situation. The history of the science does not belong to our tasks and we may leave aside the question as to the historical roots of dualism and confine ourselves to pointing out this fact and explaining the proximate causes which led to the exacerbation and bifurcation of dualism in the crisis. It is, essentially, the fact that psychology is attracted to two poles, this intrinsic presence of a “psychoteleology” and a “psychobiology,” which Dessoir [1911, p. 230] called the singing in two voices of contemporary psychology, and which in his opinion will never cease.

12: The Driving Forces of the Crisis

Now we must briefly dwell upon the proximate causes or driving forces of the crisis.

Which factors lead us to the crisis, the rupture, and which passively experience it as an inevitable evil? Naturally, we will dwell here only upon the driving forces within our science, leaving all others aside. We are justified in doing so, because the external – social and ideological – causes and phenomena are, one way or the other, represented in the final analysis by forces within the science, and they act through them. It is our intention, therefore, to analyse the proximate causes lying within the science and to refrain from a deeper analysis.

Let us say right away that the main driving force of the crisis in its final phase is the development of applied psychology as a whole.

The attitude of academic psychology toward applied psychology has up until not remained somewhat disdainful as if it had to do with a semi-exact science. Not everything is well in this area of psychology, there is no doubt about that, but nevertheless there can be no doubt for an observer who takes a bird-eye's view, i.e., the methodologist, that the leading role in the development of our science belongs to applied psychology. It represents everything of psychology which is progressive, sound, which contains a germ of the future. It provides the best methodological works. It is only by studying this area that one can come to an understanding of the meaning of what is going on and the possibility of a genuine psychology.

The center has shifted in the history of science: what was at the periphery became the center of the circle. One can say about applied psychology what can be said about philosophy which was rejected by empirical psychology: “the stone which the builders rejected is become the head stone of the corner.”

We can elucidate this by referring to three aspects. The first is practice. Here psychology was first (through industrial psychology, psychiatry, child psychology, and criminal psychology) confronted with a highly developed – industrial, educational, political, or military – practice. This confrontation compels psychology to reform its principles so that they may withstand the highest test of practice. It forces us to accommodate and introduce into our science the supply of practical psychological experiences and skills which has been gathered over thousands of years; for the church, the military, politics, and industry, insofar as they have consciously regulated and organised the mind, base themselves on an experience which is enormous, although not well ordered from the scientific viewpoint (every psychologist experienced the reforming influence of applied science). For the development of psychology, applied psychology plays the same role as medicine did for anatomy and physiology and technique for the physical sciences. The importance of the new practical psychology for the whole science cannot be exaggerated. The psychologist might dedicate a hymn to it.
A psychology which is called upon to confirm the truth of its thinking in practice, which attempts not so much to explain the mind but to understand and master it, gives the practical disciplines a fundamentally different place in the whole structure of the science than the former psychology did. There practice was the colony of theory, dependent in all its aspects on the metropolis. Theory was in no way dependent on practice. Practice was the conclusion, the application, an excursion beyond the boundaries of science, an operation which lay outside science and came after science, which began after the scientific operation was considered completed. Success or failure had practically no effect on the fate of the theory. Now the situation is the opposite. Practice pervades the deepest foundations of the scientific operation and reforms it from beginning to end. Practice sets the tasks and serves as the supreme judge of theory, as its truth criterion. It dictates how to construct the concepts and how to formulate the laws.

This leads us directly to the **second aspect**, to methodology. However strange and paradoxical it may seem at first glance, it is precisely practice as the constructive principle of science which requires a philosophy, i.e. a methodology of science. This does not in any way contradict the frivolous, “light-hearted” (in the words of Munsterberg) relation of psychotechnics to its principles. In reality, both the practice and the methodology of psychotechnics are often amazingly helpless, weak, superficial, and at times ludicrous. Psychotechnic diagnoses are vacuous and remind us of the physician's reflections about medicine in Moliere. The methodology of psychotechnics is invented ad hoc each time and lacks critical sense. It is often called picnic psychology, i.e., it is something light, temporary, half-serious. All this is true. But it does not for one moment change the fundamental state of affairs, that it is exactly this psychology which will create an iron methodology. As Munsterberg says, not only the general part, but also the examination of particular questions will force us time and again to investigate the principles of psychotechnics.

That is why I assert: despite the fact that it has compromised itself more than once, that its practical meaning is very close to zero and the theory often ludicrous, its methodological meaning is enormous. The principle and philosophy of practice is – once again – the stone which the builders rejected and which became the head stone of the corner. Here we have the whole meaning of the crisis.

Binswanger says that we do not expect to get the solution to the most general question – the supreme question of all psychology, the problem which includes all problems of psychology, the question of subjectivating and objectivating psychology – from logic, epistemology, or metaphysics, but from methodology, i.e., the theory of scientific method. We would say: from the methodology of psychotechnics, i.e., the **philosophy of practice**. The practical and theoretical value of Binet's measuring scale or other psychotechnic tests may be obviously insignificant, the test bad in itself, but as an idea, a methodological principle, a task, a perspective it is enormous. The most complex contradictions of psychological methodology are transferred to the grounds of practice and only there can they be solved. There the debate stops being fruitless, it comes to an end. “Method” means “way,” we view it as a means of knowledge acquisition. But in all its points the way is determined by the goal to which it leads. That is why practice reforms the whole methodology of the science.

The third aspect of the reforming role of psychotechnics may be understood from the first two. It is that psychotechnics is a **one-sided** psychology, it instigates a rupture and creates a real psychology. Psychiatry too transcends the boundaries of idealistic psychology. One cannot treat or cure relying on introspection. One can hardly carry this idea to a more absurd consequence than when applying it to psychiatry. Psychotechnics also realised, as was observed by Spiel'rejn, that it cannot separate psychological functions from physiological ones, and it is searching for an integral concept. About psychologists who demand inspiration from teachers, I have written that hardly any one of them would entrust the control of a ship to the captain's inspiration or the management of a factory to the engineer's enthusiasm. Each of them would select a professional sailor and an experienced technician. And these highest possible requirements for the science, this most serious practice, will revive psychology. Industry and the military, education and treatment will revive and reform the science. Husserl's eidetic psychology, which is not interested in the truth of its claims, is not fit for
the selection of tram-drivers. Neither is the contemplation of essences fit for that goal, even values are without interest. But all this will not in the least protect it against a catastrophe. The goal of such a psychology is not Shakespeare in concepts, as it was for Dilthey, but in one word — psychotechnics, i.e., a scientific theory which would lead to the subordination and mastery of the mind, to the artificial control of behaviour.

And it is Munsterberg, this militant idealist, who lays the foundations for psychotechnics, i.e., a materialistic psychology in the highest sense of the word. Stern, no less enthusiastic about idealism, is elaborating a methodology for differential psychology and reveals with fatal precision the untenability of idealistic psychology.

How could it happen that extreme idealists play into the hands of materialism? It shows that the two struggling tendencies are deeply and with objective necessity rooted in the development of psychology; how little they coincide with what the psychologist says about himself; i.e., with his subjective philosophical convictions; how inexpressibly complex the picture of the crisis is; in what mixed forms both tendencies meet; what tortuous, unexpected, paradoxical zigzags the front line in psychology makes, frequently within one and the same system, frequently within one term. Finally, it shows that the struggle between the two psychologies does not coincide with the struggle between the many conceptions and psychological schools, but stands behind them and determines them. It shows how deceptive the external forms of the crisis are and that we need to take account of the genuine meaning behind them.

Let us turn to Munsterberg. The question of causal psychology's legitimacy is of decisive importance for psychotechnics.

This one-sided causal psychology only now comes into its own . . . explanatory psychology is the answer to an unnatural, artificial question; mental life requires understanding, not explanation. Psychotechnics, however, which can only work with a causal psychology, testifies to the necessity of such an artificial statement of the question and legitimise it. The genuine meaning of explanatory psychology is only revealed in psychotechnics and, thus, the whole system of the psychological sciences culminates in it.

It is difficult to demonstrate the objective force of this tendency and the non-coincidence of the philosopher's convictions with the objective meaning of his work more clearly: materialistic psychology is unnatural, says the idealist, but I am forced to work with precisely such a psychology.

Psychotechnics is oriented toward action, practice – and there we act in a way which is fundamentally different from purely theoretical understanding and explanation. That is why psychotechnics cannot hesitate in the selection of the psychology it needs (not even when it is elaborated by consistent idealists). It is dealing exclusively with causal, objective psychology. Non-causal psychology plays no role whatsoever for psychotechnics.

It is precisely this situation that is of decisive importance for all psychotechnical sciences. It is consciously one-sided. It is the only empirical science in the full sense of the word. It is – inevitably – a comparative science. The link with physical processes is for this science so fundamental that it is a physiological psychology. It is an experimental science. And its general formula is:

We proceeded from the assumption that the only psychology relevant for psychotechnics must be a descriptive-explanatory science. We may now add that, on top of that, it must be an empirical, comparative science which takes physiology into account, and which, finally, is experimental [Munsterberg].

This means that psychotechnics introduces a revolution in the development of the science and marks an era in its development. From this viewpoint Munsterberg says that empirical psychology hardly originated before the second half of the 19th century. Even in the schools which rejected metaphysics and studied the facts research was guided by another interest. Application of the
experiment was impossible as long as psychology did not become a natural science. But along with the introduction of the experiment there evolved a paradoxical situation which would be unthinkable in the natural sciences: equipment equivalent to the first steam engine or the telegraph was well known in the laboratories, but not applied in practice. Education and law, trade and industry, social life and medicine were uninfluenced by this movement. To this very day it is considered a profanation of the investigation to connect it with practice and it is advised to wait until psychology has completed its theoretical system. But the experience of the natural sciences tells us another story. Medicine and technique did not wait until anatomy and physics celebrated their ultimate triumphs. It is not only that life needs psychology and practices it in different forms everywhere: we must also expect an upsurge in psychology from this contact with life.

Of course, Munsterberg would not be an idealist if he accepted this situation as it is and did not retain a special area for the unlimited rights of idealism. He merely transfers the debate to another area when he accepts the untenability of idealism in the area of a causal psychology that feeds on practice. He explains this “epistemological tolerance” [ibid.] and deduces it from an idealistic understanding of the essence of science which does not seek for the distinction “between true and false concepts, but between those suited or not suited for certain ultimate hypothetical [gedankliche] goals” [ibid.]. He believes that a temporary truce between psychologists can be established as soon as they leave the battlefield of psychological theory [ibid.].

Munsterberg's work is a striking example of the internal discord between a methodology determined by science and a philosophy determined by a world view, precisely because he is a methodologist who is consistent to the very end and a philosopher who is consistent to the very end, i.e., a contradictory thinker to the very end. He understands that in being a materialist in causal psychology and an idealist in teleological psychology he arrives at some sort of double-entry bookkeeping which inevitably must be unscrupulous, because the entries on the one side are different from those on the other side. For in the end only one truth is conceivable. But for him the truth is not life itself, but the logical elaboration of life, and the latter can vary, as it is determined by many viewpoints [ibid.] He understands that empirical science does not require the rejection of an epistemological point of view, but a certain theory, but in various sciences different epistemological viewpoints are possible. In the interest of practice we express the truth in one language, in another in the interests of the mind [Geist].

When natural scientists have differences of opinion these do not touch upon the fundamental assumptions of the science.

It is no problem at all for a botanist to communicate about his subject with all other plant researchers. No botanist bothers to stop to answer the question what it actually means that plants live in space and time and are ruled by causal laws [ibid.].

But the nature of psychological material does not allow us to separate the psychological propositions from philosophical theories to the extent that other empirical sciences have managed to do that. The psychologist fundamentally deceives himself when he imagines that his laboratory work can lead him to the solution of the basic questions of his science; they belong to philosophy.

The psychologist who does not want to join the philosophical debate about fundamental questions must simply tacitly accept one or the other epistemological theory as the basis of his particular investigations [ibid.].

It was exactly epistemological tolerance and not a rejection of epistemology which led Munsterberg to the idea of two psychologies, one of which contradicts the other, but both of which can be accepted by the philosopher. After all, tolerance does not stand for atheism. In the mosque he is a Mohammedan, but in the cathedral a Christian.

There is only one fundamental misunderstanding that may arise: that the idea of a dualistic psychology leads to the partial acceptance of the rights of causal psychology, that the dualism is transferred into psychology itself, which is divided into two phases; that Munsterberg proclaimed
The fundamental question as to whether a psychology that thinks along teleological lines may really exist alongside a causal psychology, whether in scientific psychology we can and should deal with apperception, task awareness, affect, will, or thought in a teleological fashion, does not concern the psychotechnician, for he knows that we can always somehow handle these events and mental performances in the language of causal psychology and that psychotechnics can only deal with this causal conception.

Thus, the two psychologies do not overlap, do not supplement each other, but they serve two truths, one in the interest of practice, the other in the interest of mind [Geist]. Double-entry bookkeeping is practiced in Munsterberg's world view, but not in psychology. The materialist will fully accept Munsterberg's conception of causal psychology and will reject dualism in science. The idealist will reject dualism as well and will fully accept the conception of a teleological psychology. Munsterberg himself proclaims epistemological tolerance and accepts both sciences, but elaborates one of them as materialist and the other as idealist. Thus, the debate and the dualism exist beyond the boundaries of causal psychology. It is not part of anything and in itself does not form part of any science.

This instructive example of the fact that in science idealism is forced to find its grounds in materialism is fully confirmed by the example of any other thinker.

Stern followed the same path. He was led to objective psychology through the problems of differential investigation, which is likewise one of the main reasons for the new psychology. We do not investigate thinkers, however, but their fate, i.e., the objective processes that stand behind them and control them. And these are not revealed through induction, but through analysis. In the words of Engels, one steam engine demonstrates the law of transformation of energy no less convincingly than 100,000 engines. We add as a mere curiosity that in the preface to the translation of Munsterberg the Russian idealistic psychologists list among his merits that he meets the aspiration of the psychology of behaviour and the requirements of an integral approach of man without pulverising man's psychophysical organisation into atoms. What the great idealists accomplish as a tragedy, the small ones repeat as a farce.

We can summarise. We view the cause of the crisis as its driving force, which is therefore not only of historical interest, but also of primary – methodological – importance, as it not only led to the development of the crisis, but continues determining its further course and fate. This cause lies in the development of applied psychology, which has led toward the reform of the whole methodology of the science on the basis of the principle of practice, i.e., towards its transformation into a natural science. This principle is pressing psychology heavily and pushing it to split into two sciences. It guarantees the right development of materialistic psychology in the future. Practice and philosophy are becoming the head stone of the corner.

Many psychologists have viewed the introduction of the experiment as a fundamental reform of psychology and have even equated experimental and scientific psychology. They predicted that the future would belong solely to experimental psychology and have viewed this epithet as a most important methodological principle. But in psychology the experiment remained on the level of a technical device, it was not utilised in a fundamental way and it led, in the case of Ach for instance, to its own negation. Nowadays many psychologists see a way out in methodology, in the correct formation of principles. They expect salvation from the other end. But their work is fruitless as well. Only a fundamental rejection of the blind empiricism which is trailing behind immediate introspectional experience and which is internally split into two parts; only the emancipation from introspection, its exclusion just like the exclusion of the eye in physics; only a rupture and the selection of a single psychology will provide the way out of the crisis. The dialectic unity of methodology and practice, applied to psychology from two sides, is the fate and destiny of one of the psychologies. A complete severance from practice and the contemplation of ideal essences is the
destiny and fate of the other. A complete rupture and separation is their common destiny and fate. This rupture began, continues, and will be completed along the lines of practice.

Gentlemen,

One cannot but be struck by a comparison of the following facts. First, the cerebral hemispheres, the higher part of the central nervous system, is a rather impressive organ. In structure it is exceedingly complex, comprising millions and millions (in man - even billions) of cells, i.e., centres or foci of nervous activity. These cells vary in size, shape and arrangement and are connected with each other by countless branches. Such structural complexity naturally suggests a very high degree of functional complexity. Consequently, it would seem that a boundless field of investigation is offered here for the physiologist. Secondly, take the dog, man's companion and friend since prehistoric times, in its various roles as hunter, sentinel, etc. We know that this complex behaviour of the dog, its higher nervous activity (since no one will dispute that this is higher nervous activity), is chiefly associated with the cerebral hemispheres. If we remove the cerebral hemispheres in the dog (Goltz and others), it becomes incapable of performing not only the roles mentioned above, but even of looking after itself. It becomes profoundly disabled and will die unless well cared for. This implies that both in respect of structure and function, the cerebral hemispheres perform considerable physiological work.

Let us turn now to man. His entire higher nervous activity is also dependent on the normal structure and functioning of the cerebral hemispheres. The moment the complex structure of his hemispheres is damaged or disturbed in one way or another, he also becomes an invalid; he can no longer freely associate with his fellows as an equal and must be isolated.

In amazing contrast to this boundless activity of the cerebral hemispheres is the scant content of the present-day physiology of these hemispheres. Up to 1870 there was no physiology of the cerebral hemispheres at all; they seemed inaccessible to the physiologist. It was in that year that Fritsch and Hitzig first successfully applied the ordinary physiological methods of stimulation and destruction to their study. Stimulation of certain parts of the cerebral cortex regularly evoked contractions in definite groups of the skeletal muscles (the cortical motor region). Extirpation of these parts led to certain disturbances in the normal activity of the corresponding groups of muscles.

Shortly afterwards H. Munk, Ferrier and others demonstrated that other regions of the cortex,
seemingly not susceptible to artificial stimulation, are also functionally differentiated. Removal of these parts leads to defects in the activity of certain receptor organs - the eye, the ear and the skin. Many researchers have been thoroughly investigating these phenomena. More precision and more details have been obtained, especially as regards the motor region, and this knowledge has even found practical application in medicine; however, investigation as yet has not gone far beyond the initial point. The essential fact is that the entire higher and complex behaviour of the animal, which is dependent on the cerebral hemispheres, as shown by the previously mentioned experiment by Goltz with the extirpation of the hemispheres in a dog, has hardly been touched upon in these investigations and is not included even in the programme of current physiological research, what do the facts relating to the cerebral hemispheres, which are now at the disposal of the physiologist, explain with regard to the behaviour of the higher animals? Is there a general scheme of the higher nervous activity? What kind of general rules govern this activity? The contemporary physiologist finds himself truly empty-handed when he has to answer these lawful questions. While the object of investigation is highly complex in relation to structure, and extremely rich in function, research in this sphere remains, as it were, in a blind alley, unable to open up before the physiologist the boundless vistas which might have been expected.

Why is this so? The reason is clear, the work of the cerebral hemispheres has never been regarded from the same point of view as that of other organs of the body, or even other parts of the central nervous system. It has been described as special psychical activity - which we feel and apprehend in ourselves and which we suppose exists in animals by analogy with human beings. Hence the highly peculiar and difficult position of the physiologist. On the one hand, the study of the cerebral hemispheres, as of all other parts of the organism, seems to come within the scope of physiology, but on the other hand, it is an object of study by a special branch of science - psychology. What, then, should be the attitude of the physiologist? Should he first acquire psychological methods and knowledge and only then begin to study the activity of the cerebral hemispheres? But there is a real complication here. It is quite natural that physiology, in analysing living matter, should always base itself on the more exact and advanced sciences - mechanics, physics and chemistry. But here we are dealing with an altogether different matter, since in this particular case we should have to rely on a science which has no claim to exactness as compared with physiology. Until recently discussion revolved even around the question whether psychology should be considered a natural science or a science at all. Without going deeply into this question, I should like to cite some facts which, although crude and superficial, seem to me very convincing. Even the psychologists themselves do not regard their science as being exact. Not so long ago James, an outstanding American psychologist, called psychology not a science, but a "hope for science." Another striking illustration has been provided by Wundt, formerly a physiologist, who became a celebrated psychologist and philosopher and even the founder of the so-called experimental psychology. Prior to the war, in 1913, a discussion took place in Germany as to the advisability of separating the psychological branch of science from the philosophical in the universities, i.e., of having two separate chairs instead of one. Wundt opposed separation, one of his arguments being the impossibility of establishing a common and obligatory examination programme' in psychology, since each professor had his own ideas of the essence of psychology. Is it not clear, then, that psychology has not yet reached the stage of an exact science?

This being the case, there is no need for the physiologist to have recourse to psychology. In view of the steadily developing natural science it would be more logical to expect that not psychology should render assistance to the physiology of the cerebral hemispheres, but, on the contrary, physiological investigation of the activity of this organ in animals should lay the foundation for the exact scientific analysis of the human subjective world. Consequently, physiology must follow its own path - the path blazed for it long ago. Taking as his starting-point the assumption that the functioning of the animal's organism, unlike that of the human being, is similar to the work of a machine, Descartes' three hundred years ago evolved the idea of the reflex as the basic activity of the nervous system. Descartes regarded every activity of the organism as a natural response to
certain external agents and believed that the connection between the active organ and the given agent, that is, between cause and effect, is achieved through a definite nervous path. In this way the study of the activity of the animal nervous system was placed on the firm basis of natural science. In the eighteenth, nineteenth and twentieth centuries the idea of the reflex had been extensively used by physiologists, but only in their work on the lower parts of the central nervous system; gradually, however, they began to study its higher parts, until finally, after Sherrington's classical works on spinal reflexes, Magnus, his successor, established the reflex nature of all the basic locomotor activities of the organism. And so experiment fully justified the idea of the reflex which, thereafter, was used in the study of the central nervous system almost up to the cerebral hemispheres. It is to be hoped that the more complex activities of the organism, including the basic locomotor reflexes - states so far referred to in psychology as anger, fear, playfulness, etc. - will soon be related to the simple reflex activity of the subcortical parts of the brain.

A bold attempt to apply the idea of the reflex to the cerebral hemispheres not only of animals but also of man, was made by I. M. Sechenov, the Russian physiologist, on the basis of the contemporary physiology of the nervous system. In a paper published in Russian in 1863 and entitled *Reflexes of the Brain* Sechenov characterised the activity of the cerebral hemispheres as reflex, i.e., determined activity. He regarded thoughts as reflexes in which the effector end is inhibited, and affects as exaggerated reflexes with a wide irradiation of excitation. A like attempt has been made in our time by Ch. Richet who introduced the concept of the psychical reflex in which the reaction to a given stimulus is determined by its union with the traces left in the cerebral hemispheres by previous stimuli. Generally, the recent physiology of the higher nervous activity related to the cerebral hemispheres tends to associate acting stimulation with traces left by previous ones (associative memory - according to J. Loeb; training, education by experience - according to other physiologists). But this was mere theorising. The time had come for a transition to the experimental analysis of the subject, and from the objective external aspect, as is the case with any other branch of natural science. This transition was determined by comparative physiology which had just made its appearance as a result of the influence of the theory of evolution. Now that it had turned its attention to the entire animal kingdom, physiology, in dealing with its lower representatives, was forced, of necessity, to abandon the anthropomorphic concept and concentrate on the scientific elucidation of the relations between the external agents influencing the animal and the responsive external activity, the locomotor reaction of the latter. This gave birth to J. Loeb's doctrine of animal tropisms; to the suggestion by Beer, Bethe and Uexküll of an objective terminology for designating the animal reactions; and finally, to the investigation by zoologists of the behaviour of the lower representatives of the animal world, by means of purely objective methods, by comparing the effect of external influences on the animal with its responsive external activity - as for example in the classical work of Jennings, etc.

Influenced by this new tendency in biology and having a practical cast of mind, American psychologists who also became interested in comparative psychology displayed a tendency to subject the external activity of animals to experimental analysis under deliberately induced conditions. Thorndike's *Animal Intelligence* (1898) must be regarded as the starting-point for investigations of this kind. In these investigations the animal was kept in a box and food placed outside, within sight. The animal, naturally, tried to reach the food, but to do so it had to open the door which in the different experiments was fastened in a different way. Tables and charts registered the speed and the manner in which the animal solved this problem. The entire process was interpreted as the formation of an association, connection between the visual and the tactile stimulation and the locomotor activity. Afterwards by means of this method, and by modifications of it, researchers studied numerous questions relating to the associative ability of various animals. Almost simultaneously with the above-mentioned work by Thorndike, of which I was not then aware, I too had arrived at the idea of the need for a similar attitude to the subject. The following episode, which occurred in my laboratory, gave birth to the idea.

While making a detailed investigation of the digestive glands I had to busy myself also with the so-
called psychical stimulation of the glands. When, together with one of my collaborators, I attempted a deeper analysis of this fact, at first in the generally accepted way, i.e., psychologically, visualising the probable thoughts and feelings of the animal, I stumbled on a fact unusual in laboratory practice. I found myself unable to agree with my colleague; each of us stuck to his point of view, and we were unable to convince each other by certain experiments. This made me definitely reject any further psychological discussion of the subject, and I decided to investigate it in a purely objective way, externally, i.e., strictly recording all stimuli reaching the animal at the given moment and observing its corresponding responses either in the form of movements or in the form of salivation (as occurred in this particular case).

This was the beginning of the investigations that I have carried on now for the past twenty-five years with the participation of numerous colleagues who joined hand and brain with me in this work and to whom I am deeply grateful. We have, of course, passed through different stages, and the subject has been advanced only gradually. At first we had but a few separate facts at our disposal, but today so much material has been accumulated by us that we can make an attempt to present it in a more or less systematised form. I am now in a position to place before you a physiological theory of the activity of the cerebral hemispheres which at any rate conforms much more to the structural and functional complexity of this organ than the theory which until now has been based on a few fragmentary, though very important, facts of modern physiology.

Thus, research along these new lines of strictly objective investigation of the higher nervous activity has been carried out mainly in my laboratories (with the participation of a hundred colleagues); work along the same lines has been carried out also by American psychologists. As for other physiological laboratories, so far only a few have begun, starting somewhat later, to investigate this subject, but in most cases their work is still in the initial stage. So far there has been one essential point of difference in the research of the Americans and in ours. Since in the case of the Americans the objective investigation is being conducted by psychologists, this means that, although psychologists study the facts from the purely external - aspect, nevertheless, in posing the problems, in analysing and formulating the results, they tend to think more in terms of psychology. The result is that with the exception of the group of "behaviourists" their work does not bear a purely physiological character. Whereas, we, having started from physiology, invariably and strictly adhere to the physiological point of view, and we are investigating and systematising the whole subject solely in a physiological way.

I shall now pass to an exposition of our material, but before doing so I should like to touch on the concept of the reflex in general, on reflexes in physiology and the so-called instincts.

In the main we base ourselves on Descartes' concept of the reflex. Of course, this is a genuinely scientific concept, since the phenomenon implied by it can be strictly determined. It means that a certain agent of the external world, or of the organism's internal medium produces a certain effect in one or other nervous receptor, which is transformed into a nervous process, into nervous excitation. The excitation is transmitted along certain nerve fibres, as if along an electric cable, to the central nervous system; thence, thanks to the established nervous connections, it passes along other nerve fibres to the working organ, where it in its turn is transformed into a special activity of the cells of this organ. Thus, the stimulating agent proves to be indispensably connected with the definite activity of the organism, as cause and effect.

It is quite obvious that the entire activity of the organism is governed by definite laws. If the animal were not (in the biological sense) strictly adapted to the surrounding world, it would, sooner or later, cease to exist. If instead of being attracted by food, the animal turned away from it, or instead of avoiding fire threw itself into it, and so on, it would perish. The animal must so react to the environment that all its responsive activity ensures its existence. The same is true if we think of life in terms of mechanics, physics and chemistry. Every material system can exist as an entity only so long as its internal forces of attraction, cohesion, etc., are equilibrated with the external forces influencing it. This applies in equal measure to such a simple object as a stone and to the most
complex chemical substance, and it also holds good for the organism. As a definite material system complete in itself, the organism can exist only so long as it is in equilibrium with the environment; the moment this equilibrium is seriously disturbed, the organism ceases to exist as a particular system. Reflexes are the elements of this constant adaptation or equilibration. Physiologists have studied and are studying numerous reflexes, these indispensable, machine-like reactions of the organism, which at the same time are inborn, i.e., determined by the peculiar organisation of the given nervous system. Reflexes, like the belts of machines made by human hands, are of two kinds: the positive and the negative inhibitory, in other words, those which excite certain activities and those which inhibit them. Although investigation of these reflexes by physiologists has been under way for a long time, it is, of course, a long way from being finished. More and more new reflexes are being discovered; the properties of the receptor organs, on the surface on which it is walking. In what way does it differ, say, from inclining the head and closing the lids when something flashes near the eye? We should call the latter a defensive reflex, and the first an alimentary instinct, although in the case of the pecking, if it is caused by the sight of a stain, nothing but inclining the head and a movement of the beak occurs.

Further, it has been noted that instincts are more complex than reflexes. But there are exceedingly complex reflexes which no one designates as instincts. Take, for example, vomiting. This is a highly complex action and one that involves extraordinary co-ordination of a large number of muscles, both striated and smooth, usually employed in other functions of the organism and spread over a large area. It also involves the secretion of various glands which normally participate in quite different activities of the organism.

The fact that instincts involve a long chain of successive actions, while reflexes are, so to speak, one-storied, has also been regarded as a point of distinction between them. By way of example let us take the building of a nest, or of animal dwellings in general. Here, of course, we have a long chain of actions: the animal must search for the material, bring it to the site and put it together and secure it. If we regard this as a reflex, we must assume that the ending of one reflex excites a new one, or, in other words, that these are chain-reflexes. But such chain activities are by no means peculiar to instincts alone. We are familiar with many reflexes which are also interlocked. Here is an instance. When we stimulate an afferent nerve, for example, the n. ischiadicus, there takes place a reflex rise of blood pressure. This is the first reflex. The high pressure in the left ventricle of the heart and in the first part of the aorta acts as a stimulus to another reflex: it stimulates the endings of the n. depressoris cordis which evokes a depressor reflex moderating the effect of the first reflex. Let us take the chain-reflex recently established by Magnus. A cat, even deprived of the cerebral hemispheres will in most cases fall on its feet when thrown from a height. How does this occur? The change in the spatial position of the otolithic organ of the ear causes a certain reflex contraction of the muscles in the neck, which restores the animal's head to a normal position in relation to the horizon. This is the first reflex. The end of this reflex - the contraction of the muscles in the neck and the righting of the head in general - stimulates a fresh reflex on certain muscles of the trunk and limbs which come into action and, in the end, restore the animal's proper standing posture.

Yet another difference between reflexes and instincts has been assumed, namely, that instincts often depend on the internal state or condition of the organism. For instance, a bird builds its nest only in the mating season. Or, to take a simpler example, when the animal is sated, it is no longer attracted by food and stops eating. The same applies to the sexual instinct, which is connected with the age of the organism, as well as with the state of the reproductive glands. In general the hormones, products of the glands of internal secretion, are of considerable importance in this respect. But this, too, is not a peculiar property of the instincts alone. The intensity of any reflex, as well as its presence or absence, directly depends on the state of excitability of the reflex centres which in turn always depends on the chemical and physical properties of the blood (automatic stimulation of the centres) and on the interaction of different reflexes.

Finally, importance is sometimes attached to the fact that reflexes are related to the activity of separate organs, whereas instincts involve the activity of the organism as a whole, i.e., actually the
whole skeleto-muscular system. However, we know from the works of Magnus and de Kleyn that standing, walking, and bodily balance in general, are reflexes.

Thus, reflexes and instincts alike are natural reactions of the organism to certain stimulating agents, and consequently there is no need to designate them by different terms. The term "reflex" is preferable, since a strictly scientific sense has been imparted to it from the very outset.

The aggregate of these reflexes constitutes the foundation of the nervous activity both in men and animals. Consequently, thorough study of all these fundamental nervous reactions of the organism is, of course, a matter of great importance. Unfortunately, as already mentioned, this is a long way from having been accomplished, especially in the case of those reflexes which are called instincts. Our knowledge of these instincts is very limited and fragmentary. We have but a rough classification of them - alimentary, self-defensive, sexual, parental and social. But almost each of these groups often includes numerous separate reflexes, some of which have not been even identified by us, while some are confused with others or, at least, they are not fully appreciated by us as to their vital importance. To what extent this subject remains unelucidated and how full it is still of gaps can be demonstrated by this example from my own experience.

Once, in the course of our experimental work which I shall describe presently, we were puzzled by the peculiar behaviour of our animal. This was a tractable dog with which we were on very friendly terms. The dog was given a rather easy assignment. It was placed in the stand and had its movements restricted only by soft loops fastened round its leys (to which at first it did not react at all). Nothing else was done except to feed it repeatedly at intervals of several minutes. At first the dog was quiet and ate willingly, but as time went on it became more and more excited: it began to struggle against the surrounding objects, tried to break loose, pawing at the floor, gnawing the supports of the stand, etc. This ceaseless muscular exertion brought on dyspnoea and a continuous secretion of saliva; this persisted for weeks, becoming worse and worse, with the result that the dog was no longer fit for our experimental work. This phenomenon puzzled us for a long time. We advanced many hypotheses as to the possible reason for this unusual behaviour, and although we had by then acquired sufficient knowledge of the behaviour of dogs, our efforts were in vain until it occurred to us that it might be interpreted quite simply - as the manifestation of a freedom reflex, and that the dog would not remain quiet so long as its movements were constrained. We overcame this reflex by means of another - a food reflex. We began to feed the dog only in the stand. At first it ate sparingly and steadily lost weight, but gradually it began to eat more - until it consumed the whole of its daily ration. At the same time it became quiet during the experiments; the freedom reflex was thus inhibited. It is obvious that the freedom reflex is one of the most important reflexes, or, to use a more general term, reactions of any living being. But this reflex is seldom referred to, as if it were not finally recognised. James does not enumerate it even among the special human reflexes (instincts). Without a reflex protest against restriction of an animal's movements any insignificant obstacle in its way would interfere with the performance of certain of its important functions. As we know, in some animals the freedom reflex is so strong that when placed in captivity they reject food, pine away and die.

Let us turn to another example. There is a reflex which is still insufficiently appreciated and which can be termed the investigatory reflex. I sometimes call it the "What-is-it?" reflex. It also belongs to the fundamental reflexes and is responsible for the fact that given the slightest change in the surrounding world both man and animals immediately orientate their respective receptor organs towards the agent evoking the change. The biological significance of this reflex is enormous. If the animal were not provided with this reaction, its life, one may say, would always hang by a thread. In man this reflex is highly developed, manifesting itself in the form of an inquisitiveness which gives birth to scientific thought, ensuring for us a most reliable and unrestricted orientation in the surrounding world. Still less elucidated and differentiated is the category of negative, inhibitory reflexes (instincts) induced by any strong stimuli, or even by weak but unusual stimuli. So-called animal hypnotism belongs, of course, to this category.
Thus, the fundamental nervous reactions both of man and animals are inborn in the form of reflexes. And I repeat once more that it is highly important to have a complete list of these reflexes and properly to classify them, since, as we shall see later, all the remaining nervous activity of the organism is based on these reflexes.

However, although the reflexes just described constitute the fundamental condition for the safety of the organism in the surrounding nature, they in themselves are not sufficient to ensure a lasting, stable and normal existence for the organism. This is proved by the following experiment, carried out on a dog in which the cerebral hemispheres have been extirpated. Besides the internal reflexes, such a dog retains the fundamental external reflexes. It is attracted by food; it keeps away from destructive stimuli; it displays the investigatory reflex pricking up its ears and lifting its head to sound. It possesses the freedom reflex as well, and strongly resists any attempt at capture. Nevertheless, it is an invalid and would not survive without care. Evidently something vital is missing in its nervous activity. But what? It is impossible not to see that the number of stimulating agents evoking reflex reactions in this dog has decreased considerably, that the stimuli act at a very short distance and are of a very elementary and very general character, being undifferentiated. Hence, the equilibrium of this higher organism with the environment in a wide sphere of its life has also become very elementary, limited and obviously inadequate.

Let us now revert to the simple example with which we began our investigations. When food or some unpalatable substance gets into the mouth of the animal, it evokes a secretion of saliva which moistens, dissolves and chemically alters the food, or in the case of disagreeable substances removes them and cleanses the mouth. This reflex is caused by the physical and chemical properties of the above-mentioned substances when they come in contact with the mucous membrane of the oral cavity. However, a similar secretary reaction is produced by the same substances when placed at a distance from the dog and act on it only by appearance and smell. Moreover, even the sight of the vessel from which the dog is fed suffices to evoke salivation, and what is more, this reaction can be produced by the sight of the person who usually brings the food, even by the sound of his footsteps in the next room. All these numerous, distant, complex and delicately differentiated stimuli lose their effect irretrievably when the dog is deprived of the cerebral hemispheres; only the physical and chemical properties of substances, when they come in contact with the mucous membrane of the mouth, retain their effect. Meanwhile, the processing significance of the lost stimuli is, in normal conditions, very great. Dry food immediately encounters plenty of the required liquid; unpalatable substances, which often destroy the mucous membrane of the mouth, are removed from it by a layer of saliva rapidly diluted and so on. But their significance is still greater when they bring into action the motor component of the alimentary reflex, i.e., when the seeking of food is effected.

Here is another important example of the defensive reflex. The strong animals prey on those smaller and weaker, and the latter must inevitably perish if they begin to defend themselves only when the fangs and claws of the enemy are already in their flesh. But the situation is quite different when the defensive reaction arises at the sight and sound of the approaching foe. The weak animal has a chance of escaping by seeking cover or in flight.

What, then, would be our general summing up of this difference in attitude of the normal and of the decorticated animal to the external world? What is the general mechanism of this distinction and what is its basic principle?

It is not difficult to see that in normal conditions the reactions of the organism are evoked not only by those agents of the external world that are essential for the organism, i.e., the agents that bring direct benefit or harm to the organism, but by other countless agents which are merely signals of the first agents, as demonstrated above. It is not the sight and sound of the strong animal which destroy the smaller and weaker animal, but its fangs and its claws. However, the signalling, or to use Sherrington's term, the distant stimuli, although comparatively limited in number, play a part in the afore-mentioned reflexes. The essential feature of the higher nervous activity, with which we shall
be concerned and which in the higher animal is probably inherent in the cerebral hemispheres alone, is not only the action of countless signalling stimuli, rather it is the important fact that in certain conditions their physiological action changes.

In the above-mentioned salivary reaction now one particular vessel acted as a signal, now another, now one man, now another - strictly depending on the vessel that contained the food or the unpalatable substances before they were introduced in the dog's mouth, and which person brought and gave them to the dog. This, clearly, makes the machine-like activity of the organism still more precise and perfect. The environment of the animal is so infinitely complex and is so continuously in a state of flux, that the intricate and complete system of the organism has the chance of becoming equilibrated with the environment only if it is also in a corresponding state of constant flux. Hence, the fundamental and most general activity of the cerebral hemispheres is signalling, the number of signals being infinite and the signalisation variable.

Further Reading:
- Biography
- Vygotsky
- Freud
- Helmholtz
- James
- Wundt

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B F Skinner (1989)

The Origins of Cognitive Thought


What is felt when one has a feeling is a condition of one's body, and the word used to describe it almost always comes from the word for the cause of the condition felt. The evidence is to be found in the history of the language-in the etymology of the words that refer to feelings (see Chapter 1). Etymology is the archaeology of thought. The great authority in English is the Oxford English Dictionary (1928), but a smaller work such as Skeat's Etymological Dictionary of the English Language (1956) will usually suffice. We do not have all the facts we should like to have, because the earliest meanings of many words have been lost, but we have enough to make a plausible general case. To describe great pain, for example, we say agony. The word first meant struggling or wrestling, a familiar cause of great pain. When other things felt the same way, the same word was used.

A similar case is made here for the words we use to refer to states of mind or cognitive processes. They almost always began as references either to some aspect of behaviour or to the setting in which behaviour occurred. Only very slowly have they become the vocabulary of something called mind. Experience is a good example. As Raymond Williams (1976) has pointed out, the word was not used to refer to anything felt or introspectively observed until the 19th century. Before that time it meant, quite literally, something a person had "gone through" (from the Latin expiriri), or what we should now call an exposure to contingencies of reinforcement. This paper reviews about 80 other words for states of mind or cognitive processes. They are grouped according to the bodily conditions that prevail when we are doing things, sensing things, changing the way we do or sense things (learning), staying changed (remembering), wanting, waiting, thinking, and "using our minds."
DOING

The word *behave* is a latecomer. The older word was *do*. As the very long entry in the *Oxford English Dictionary* (1928) shows, do has always emphasised consequences—the effect one has on the world. We describe much of what we ourselves do with the words we use to describe what others do. When asked, "What did you do?", "What are you doing?", or "What are you going to do?" we say, for example, "I wrote a letter," "I am reading a good book," or "I shall watch television." But how can we describe what we feel or introspectively observe at the time?

There is often very little to observe. Behaviour often seems spontaneous; it simply happens. We say it "occurs" as in "It occurred to me to go for a walk." We often replace "it" with "thought" or "idea" ("The thought—or idea-occurred to me to go for a walk"), but what, if anything, occurs is the walk. We also say that behaviour comes into our possession. We announce the happy appearance of the solution to a problem by saying "I have it!"

We report an early stage of behaving when we say, "I feel like going for a walk." That may mean "I feel as I have felt in the past when I have set out for a walk." What is felt may also include something of the present occasion, as if to say, "Under these conditions I often go for a walk" or it may include some state of deprivation or aversive stimulation, as if to say, "I need a breath of fresh air."

The bodily condition associated with a high probability that we shall behave or do something is harder to pin down and we resort to metaphor. Since things often fall in the direction in which they lean, we say we are *inclined* to do something, or have an *inclination* to do it. If we are strongly inclined, we may even say we are *bent* on doing it. Since things also often move in the direction in which they are pulled, we say that we *tend* to do things (from the Latin *tendere*, to stretch or extend) or that our behaviour expresses an *intention*, a cognitive process widely favoured by philosophers at the present time.

We also use *attitude* to refer to probability. An attitude is the *position, posture, or pose* we take when we are about to do something. For example, the pose of actors suggests something of what they are engaged in doing or are likely to do in a moment. The same sense of pose is found in *dispose and propose* ("I am disposed to go for a walk...... I propose to go for a walk"). Originally a synonym of *propose*, *purpose* has caused a great deal of trouble. Like other words suggesting probable action, it seems to point to the future. The future cannot be acting now, however, and elsewhere in science purpose has given way to words referring to past consequences. When philosophers speak of intention, for example, they are almost always speaking of operant behaviour.

As an experimental analysis has shown, behaviour is shaped and maintained by its consequences, but only by consequences that lie in the past. We do what we do because of what *has* happened, not what *will* happen. Unfortunately, what has happened leaves few observable traces, and why we do what we do and how likely we are to do it are therefore largely beyond the reach of introspection. Perhaps that is why, as we shall see later, behaviour has so often been attributed to an initiating, originating, or creative act of will.

SENSING

To respond effectively to the world around us, we must see, hear, smell, taste, or feel it. The ways in which behaviour is brought under the control of stimuli can be analysed without too much trouble, but what we observe when we see ourselves seeing something is the source of a great misunderstanding. We say we *perceive* the world in the literal sense of taking it in (from the Latin *per* and *capere*, to take). (*Comprehend* is a close synonym, part of which comes from *prehendere*, to seize or grasp.) We say, "I take your meaning." Since we cannot take in the world itself, it has been assumed that we must make a copy. Making a copy cannot be all there is to seeing, however, because we still have to see the copy. Copy theory involves an infinite regress. Some cognitive psychologists have tried to avoid it by saying that what is taken in is a representation perhaps a
digital rather than an analog copy. When we recall ("call up an image of") what we have seen, however, we see something that looks pretty much like what we saw in the first place, and that would be an analog copy. Another way to avoid the regress is to say that at some point we interpret the copy or representation. The origins of interpret are obscure, but the word seems to have had some connection with price; an interpreter was once a broker. Interpret seems to have meant evaluate. It can best be understood as something we do.

The metaphor of copy theory has obvious sources. When things reinforce our looking at them, we continue to look. We keep a few such things near us so that we can look at them whenever we like. If we cannot keep the things themselves, we make copies of them, such as paintings or photographs. Image, a word for an internal copy, comes from the Latin imago. It first meant a colored bust, rather like a wax-work museum effigy. Later it meant ghost. Effigy, by the way, is well chosen as a word for a copy, because it first meant something constructed-from the Latin fingere. There is no evidence, however, that we construct anything when we see the world around us or when we see that we are seeing it.

A behavioural account of sensing is simpler. Seeing is behaving and, like all behaving, is to be explained either by natural selection (many animals respond visually shortly after birth) or operant conditioning. We do not see the world by taking it in and processing it. The world takes control of behaviour when either survival or reinforcement has been contingent upon it. That can occur only when something is done about what is seen. Seeing is only part of behaving; it is behaving up to the point of action. Since behaviour analysts deal only with complete instances of behaviour, the sensing part is out of reach of their instruments and methods and must, as we shall see later, be left to physiologists.

**CHANGING AND STAYING CHANGED**

Learning is not doing; it is changing what we do. We may see that behaviour has changed, but we do not see the changing. We see reinforcing consequences but not how they cause a change. Since the observable effects of reinforcement are usually not immediate, we often overlook the connection. Behaviour is then often said -to grow or develop. Develop originally meant to unfold, as one unfolds a letter. We assume that what we see was there from the start. Like pre-Darwinian evolution (where to evolve meant to unroll as one unrolled a scroll), developmentalism is a form of creationism.

Copies or representations play an important part in cognitive theories of learning and memory, where they raise problems that do not arise in a behavioural analysis. When we must describe something that is no longer present, the traditional view is that we recall the copy we have stored. In a behavioural analysis, contingencies of reinforcement change the way we respond to stimuli. It is a changed person, not a memory, that has been "stored."

Storage and retrieval become much more complicated when we learn and recall how something is done. It is easy to make copies of things we see, but how can we make copies of the things we do? We can model behaviour for someone to imitate, but a model cannot be stored. The traditional solution is to go digital. We say the organism learns and stores rules. When, for example, a hungry rat presses a lever and receives food and the rate of pressing immediately increases, cognitive psychologists want to say that the rat has learned a rule. It now knows and can remember that "pressing the lever produces food." But "pressing the lever produces food" is our description of the contingencies we have built into the apparatus. We have no reason to suppose that the rat formulates and stores such a description. The contingencies change the rat, which then survives as a changed rat. As members of a verbal species we can describe contingencies of reinforcement, and we often do because the descriptions have many practical uses (for example, we can memorise them and say them again whenever circumstances demand it) but there is no introspective or other evidence that we verbally describe every contingency that affects our behaviour, and much evidence to the contrary.
Some of the words we use to describe subsequent occurrences of behaviour suggest storage. *Recall-call* back-is obviously one of them; *recollect* suggests "bringing together" stored pieces. Under the influence of the computer, cognitive psychologists have turned to *retrieve-literally" to find again" (cf. the French *trouver*), presumably after a search. The etymology of *remember*, however, does not imply storage. From the Latin *me or*, it means to "mindful of again" and that usually means to do again what we did before. To remember what something looks like is to do what we did when we saw it. We needed no copy then, and we need none now. We *recognise* things in the sense of "recognising" them responding to them now as we did in the past.) As a thing, a memory must be something stored, but as an action "memorising" simply means doing what we must do to ensure that we can behave again as we are behaving now.

**WANTING**

Many cognitive terms describe bodily states that arise when strong behaviour cannot be executed because a necessary condition is lacking. The source of a general word for states of that kind is obvious: when something is wanting, we say we *want* it. In dictionary terms, to *want* is to "suffer from the want of." *Suffer* originally meant "to undergo," but now it means "to be in pain," and strong wanting can indeed be painful. We escape from it by doing anything that has been reinforced by the thing that is now wanting and wanted.

A near synonym of *want is need*. It, too, was first tied closely to suffering; to be in need was to be under restraint or duress. (Words tend to come into use when the conditions they describe are conspicuous.) Felt is often added: one has a *felt need*. We sometimes distinguish between want and need on the basis of the immediacy of the consequence. Thus, we *want* something to eat, but we *need* a taxi in order to do something that will have later consequences.

*Wishing and hoping* are also states of being unable to do something we are strongly inclined to do. The putted golf ball rolls across the green, but we can only *wish or will* it into the hole. (*Wish* is close to *will*. The Anglo-Saxon *willan* meant "wish," and the *would* in "Would that it were so" is not close to the past tense of will.)

When something we need is missing, we say we *miss* it. When we want something for a long time, we say we *long* for it. We long to see someone we love who has long been absent.

When past consequences have been aversive, we do not hope, wish, or long for them. Instead, we *worry* or feel *anxious* about them. Worry first meant "choke" (a dog worries the rat it has caught), and *anxious* comes from another word for choke. We cannot do anything about things that have already happened, though we are still affected by them. We say we are *sorry* for a mistake we have made. *Sorry* is a weak form of *sore*. As the slang expression has it, we may be "sore about something." We *resent* mistreatment, quite literally, by "feeling it again" (*resent and sentiment* share a root).

Sometimes we cannot act appropriately because we do not have the appropriate behaviour. When we have lost our way, for example, we say we feel *lost*. To be *bewildered* is like being in a wilderness. In such a case, *we wander* ("wend our way aimlessly") or *wonder* what to do. The wonders of the world were so unusual that no one responded to them in normal ways. We stand in *awe* of such things, and *awe* comes from a Greek word that meant "anguish" or "terror." *Anguish, like anxiety*, once meant "choked," and *terror* was a violent trembling. A *miracle*, from the Latin *admirare*, is "something to be wondered at," or about.

Sometimes we cannot respond because we are taken unawares; we are *surprised* (the second syllable of which comes from the Latin *prehendere*, "to seize or grasp"). The story of Dr. Johnson's wife is a useful example. Finding the doctor kissing the maid, she is said to have exclaimed, "I am surprised!" "No," said the doctor, "I am surprised; you are astonished!" *Astonished, like astounded*, first meant "to be alarmed by thunder." Compare the French *etonner and tonnere*. 
When we cannot easily do something because our behaviour has been mildly punished, we are 
embarrassed or barred. Conflicting responses find us perplexed: they are "interwoven" or 
"entangled." When a response has been inconsistently reinforced, we are diffident, in the sense of 
not trusting. Trust comes from a Teutonic root suggesting consolation, which in turn has a distant 
Greek relative meaning "whole." Trust is bred by consistency.

WAITING

Wanting, wishing, worrying, resenting, and the like are often called "feelings." More likely to be 
called "states of mind" are the bodily conditions that result from certain special temporal 
arrangements of stimuli, responses, and reinforcers. The temporal arrangements are much easier to 
analyse than the states of mind that are said to result.

Watch is an example. It first meant "to be awake." The night watch was someone who stayed awake. 
The word alert comes from the Italian for "a military watch." We watch television until we fall 
asleep.

Those who are awake may be aware of what they are doing; aware is close to wary or cautious. 
(Cautious comes from a word familiar to us in caveat emptor) Psychologists have been especially 
interested in awareness, although they have generally used a synonym, consciousness.

One who watches may be waiting for something to happen, but waiting is more than watching. It is 
something we all do but may not think of as a state of mind. Consider waiting for a bus. Nothing we 
have ever done has made the bus arrive, but its arrival has reinforced many of the things we do 
while waiting. For example, we stand where we have most often stood and look in the direction in 
which we have most often looked when buses have appeared. Seeing a bus has also been strongly 
reinforced, and we may see one while we are waiting, either in the sense of "thinking what one 
would look like" or by mistaking a truck for a bus.

Waiting for something to happen is also called expecting, a more prestigious cognitive term. To 
expect is "to look forward to" (from the Latin expectare). To anticipate is "to do other things 
beforehand," such as getting the bus fare ready. Part of the word comes from the Latin capere "to 
take." Both expecting and anticipating are forms of behaviour that have been adventitiously 
reinforced by the appearance of something. (Much of what we do when we are waiting is public. 
Others can see us standing at a bus stop and looking in the direction from which buses come. An 
observant person may even see us take a step forward when a truck comes into view, or reach for a 
coin as the bus appears. We ourselves "see" something more, of course. The contingencies have 
worked private changes in us, to some of which we alone can respond.)

THINKING

It is widely believed that behaviour analysts cannot deal with the cognitive processes called 
thinking. We often use think to refer to weak behaviour. If we are not quite ready to say, "He is 
wrong," we say, "I think he is wrong." Think is often a weaker word for know; we say, "I think this 
is the way to do it" when we are not quite ready to say, "I know this is the way" or "This is the 
way." We also say think when stronger behaviour is not feasible. Thus, we think of what something 
looks like when it is not there to see, and we think of doing something that we cannot at the moment 
do.

Many thought processes, however, have nothing to do with the distinction between weak and strong 
behaviour or between private and public, overt and covert. To think is to do something that makes 
other behaviour possible. Solving a problem is an example. A problem is a situation that does not 
evolve an effective response; we solve it by changing the situation until a response occurs. 
Telephoning a friend is a problem if we do not know the number, and we solve it by looking up the 
number. Etymologically, to solve is "to loosen or set free," as sugar is dissolved in coffee. This is the
sense in which thinking is responsible for doing. "It is how people think that determines how they act." Hence, the hegemony of mind. But again the terms we use began as references to behaviour. Here are a few examples:

1. When no effective stimulus is available we sometimes expose one. We discover things by uncovering them. To detect a signal does not mean to respond to it; it means to remove something (the tegmen) that covers it.
2. When we cannot uncover a stimulus, we sometimes keep an accessible one in view until a response occurs. Observe and regard both come from words that meant "to hold or keep in view," the latter from the French garder Consider once meant "to look steadily at the stars until something could be made of them" (consider and sidereal have a common root). Contemplate, another word for think, once meant "to look at a template or plan of the stars." (In those days all one could do to make sense of the stars was to look at them.)
3. We not only look at things to see them better, we look for them. We search or explore. To look for a pen is to do what one has done in the past when a pen came into view. (A pigeon that pecks a spot because doing so has been occasionally reinforced will "look for it" after it has been taken away by doing precisely what it did when the spot was there-moving its head in ways that brought the spot into view.) We search in order to find, and we do not avoid searching by contriving something to be seen, because contrive, like retrieve, is from the French trouver, "to find."
4. We bring different things together to make a single response feasible when we concentrate, from an older word concentre, "to join in a center."
5. We do the reverse when we separate things so that we can more easily deal with them in different ways. We sift them, as if we were putting them through a sieve. The cern in discern (Latin cernere) means "to separate or set apart."
6. We mark things so that we shall be more likely to notice them again. Distinguish, a good cognitive term, once meant "to mark by pricking." Mark is strongly associated with boundaries; animals mark the edges of their territories.
7. To define is literally "to mark the bounds or end" (finis) of something. We also determine what a word means by indicating where the referent terminates.
8. We compare things, literally, by "putting them side by side" so that we can more easily see whether they match. The par in compare means "equal." Par value is equal value. In golf, par is the score to be matched.
9. We speculate about things in the sense of looking at them from different angles, as in a specula or mirror.
10. Cogitate, an old word for think, first meant "to shake up." A conjecture is something "thrown out" for consideration. We accept or reject things that occur to us in the sense of taking or throwing them back, as if we were fishing.
11. Sometimes it helps to change one mode of stimulation into another. We do so when we convert the "heft" of an object into its weight, read on a scale. By weighing things we react more precisely to their weight. Ponder, deliberate, and examine, good cognitive processes, all once meant "to weigh." Ponder is part of ponderous, the liber in deliberate is the Latin libra, "a scales," and examine meant "the tongue of a balance."
12. We react more precisely to the number of things in a group by counting. One way to count is to recite one, two, three, and soon, while ticking off (touching) each item. Before people learned to count, they recorded the number of things in a group by letting a pebble stand for each thing. The pebbles were called calculi and their use calculation. There is a long, but unbroken, road from pebbles to silicon chips.
13. After we have thought for some time, we may reach a decision. To decide once meant simply to cut off or bring to an end.
14. A better word for decide is conclude, "to close a discussion." What we conclude about something is our last word.
It is certainly no accident that so many of the terms we now use to refer to cognitive processes once referred either to behaviour or to the occasions on which behaviour occurs. It could be objected, of course, that what a word once meant is not what it means now. Surely there is a difference between weighing a sack of potatoes and weighing the evidence in a court of law. When we speak of weighing evidence we are using a metaphor. But a metaphor is a word that is "carried over" from one referent to another on the basis of a common property. The common property in weighing is the conversion of one kind of thing (potatoes or evidence) into another (a number on a scale or a verdict). Once we have seen this weighing done with potatoes it is easier to see it done with evidence. Over the centuries human behaviour has grown steadily more complex as it has come under the control of more complex environments. The number and complexity of the bodily conditions felt or introspectively observed have grown accordingly, and with them has grown the vocabulary of cognitive thinking.

We could also say that weight becomes abstract when we move from potatoes to evidence. The word is indeed abstracted in the sense of its being drawn away from its original referent, but it continues to refer to a common property, and, as in the case of metaphor, in a possibly more decisive way. The testimony in a trial is much more complex than a sack of potatoes, and "guilty" probably implies more than "ten pounds." But abstraction is not a matter of complexity. Quite the contrary Weight is only one aspect of a potato, and guilt is only one aspect of a person. Weight is as abstract as guilt. It is only under verbal contingencies of reinforcement that we respond to single properties of things or persons. In doing so we abstract the property from the thing or person.

One may still argue that at some point the term is abstracted and carried over, not to a slightly more complex case, but to something of a very different kind. Potatoes are weighed in the physical world; evidence is weighed in the mind, or with the help of the mind, or by the mind. And that brings us to the heart of the matter.

MIND

The battle cry of the cognitive revolution is "Mind is back!" A "great new science of mind" is born. Behaviourism nearly destroyed our concern for it, but behaviourism has been overthrown, and we can take up again where the philosophers and early psychologists left off.

Extraordinary things have certainly been said about the mind. The finest achievements of the species have been attributed to it; it is said to work at miraculous speeds in miraculous ways. But what it is and what it does are still far from clear. We all speak of the mind with little or no hesitation, but we pause when asked for a definition. Dictionaries are of no help. To understand what mind means we must first look up perception, idea, feeling, intention, and many other words we have just examined, and we shall find each of them defined with the help of the others. Perhaps from people who did not know precisely what we were talking about, and we have no sensory nerves going to the parts of the brain in which the most important events presumably occur. Many cognitive psychologists recognise these limitations and dismiss the words we have been examining as the language of "common sense psychology." The mind that has made its comeback is therefore not the mind of Locke or Berkeley or of Wundt or William James. We do not observe it; we infer it. We do not see ourselves processing information, for example. We see the materials that we process and the product, but not the producing. We now treat mental processes like intelligence, personality, or character traits-as things no one ever claims to see through introspection. Whether or not the cognitive revolution has restored mind as the proper subject matter of psychology, it has not restored introspection as the proper way of looking at it. The behaviourists' attack on introspection has been devastating.

Cognitive psychologists have therefore turned to brain science and computer science to confirm their theories. Brain science, they say, will eventually tell us what cognitive processes really are. They will answer, once and for all, the old questions about monism, dualism, and interactionism. By building machines that do what people do, computer science will demonstrate how the mind works.
What is wrong with all this is not what philosophers, psychologists, brain scientists, and computer scientists have found or will find; the error is the direction in which they are looking. No account of what is happening inside the human body, no matter how complete, will explain the origins of human behaviour. What happens inside the body is not a beginning. By looking at how a clock is built, we can explain why it keeps good time, but not why keeping time is important, or how the clock came to be built that way. We must ask the same questions about a person. Why do people do what they do, and why do the bodies that do it have the structures they have? We can trace a small part of human behaviour, and a much larger part of the behaviour of other species, to natural selection and the evolution of the species, but the greater part of human behaviour must be traced to contingencies of reinforcement, especially to the very complex social contingencies we call cultures. Only when we take those histories into account can we explain why people behave as they do.

That position is sometimes characterised as treating a person as a black box and ignoring its contents. Behaviour analysts would study the invention and uses of clocks without asking how clocks are built. But nothing is being ignored. Behaviour analysts leave what is inside the black box to those who have the instruments and methods needed to study it properly. There are two unavoidable gaps in any behavioural account: one between the stimulating action of the environment and the response of the organism, and one between consequences and the resulting change in behaviour. Only brain science can fill those gaps. In doing so it completes the account; it does not give a different account of the same thing. Human behaviour will eventually be explained, because it can only be explained by the cooperative action of ethology, brain science, and behaviour analysis.

The analysis of behaviour need not wait until brain science has done its part. The behavioural facts will not be changed, and they suffice for both a science and a technology. Brain science may discover other kinds of variables affecting behaviour, but it will turn to a behavioural analysis for the clearest account of their effects.

**CONCLUSION**

Verbal contingencies of reinforcement explain why we report what we feel or introspectively observe. The verbal culture that arranges such contingencies would not have evolved if it had not been useful. Bodily conditions are not the causes of behaviour but they are collateral effects of the causes, and people's answers to questions about how they feel or what they are thinking often tell us something about what has happened to them or what they have done. We can understand them better and are more likely to anticipate what they will do. The words they use are part of a living language that can be used without embarrassment by cognitive psychologists and behaviour analysts alike in their daily lives.

But not in their science! A few traditional terms may survive in the technical language of a science, but they are carefully defined and striped by usage of their old connotations. Science requires a language. We seem to be giving up the effort to explain our behaviour by reporting what we feel or introspectively observe in our bodies, but we have only begun to construct a science needed to analyse the complex interactions between the environment and the body and the behaviour to which it gives rise.

**Further Reading:**

Biography | Chomsky | Turing | Piaget
Vygotsky | Marxist Psychology
Philosophy Archive @ marxists.org
GENETIC EPISTEMOLOGY attempts to explain knowledge, and in particular scientific knowledge, on the basis of its history, its sociogenesis, and especially the psychological origins of the notions and operations upon which it is based. These notions and operations are drawn in large part from common sense, so that their origins can shed light on their significance as knowledge of a somewhat higher level. But genetic epistemology also takes into account, wherever possible, formalisation - in particular, logical formalisations applied to equilibrated thought structures and in certain cases to transformations from one level to another in the development of thought.

The description that I have given of the nature of genetic epistemology runs into a major problem, namely, the traditional philosophical view of epistemology. For many philosophers and epistemologists, epistemology is the study of knowledge as it exists at the present moment; it is the analysis of knowledge for its own sake and within its own framework without regard for its development. For these persons, tracing the development of ideas or the development of operations may be of interest to historians or to psychologists but is of no direct concern to epistemologists. This is the major objection to the discipline of genetic epistemology, which I have outlined here.

But it seems to me that we can make the following reply to this objection. Scientific knowledge is in perpetual evolution; it finds itself changed from one day to the next. As a result, we cannot say that on the one hand there is the history of knowledge, and on the other its current state today, as if its current state were somehow definitive or even stable. The current state of knowledge is a moment in history, changing just as rapidly as the state of knowledge in the past has ever changed and, in many instances, more rapidly. Scientific thought, then, is not momentary; it is not a static instance; it is a process. More specifically, it is a process of continual construction and reorganisation. This is true in almost every branch of scientific investigation. I should like to cite just one or two examples.

The first example, which is almost taken for granted, concerns the area of contemporary physics or, more specifically, microphysics, where the state of knowledge changes from month to month and certainly alters significantly within the course of a year. These changes often take place even within the work of a single author who transforms his view of his subject matter during the course of his career.

Let us take as a specific instance Louis de Broglie in Paris. A few years ago de Broglie adhered to Niels Bohr's view of indeterminism. He believed with the Copenhagen school that, behind the indeterminism of microphysical events, one could find no determinism, that indeterminism was a very deep reality and that one could even demonstrate the reasons for the necessity of this indeterminism. Well, as it happens, new facts caused de Broglie to change his mind, so that now he maintains the very opposite point of view. So here is one example of transformation in scientific thinking, not over several successive generations but within the career of one creative man of science.
Let us take another example from the area of mathematics. A few years ago the Bourbaki group of mathematicians attempted to isolate the fundamental structures of all mathematics. They established three mother structures: an algebraic structure, a structure of ordering, and a topological structure, on which the structuralist school of mathematics came to be based, and which was seen as the foundation of all mathematical structures, from which all others were derived. This effort of theirs, which was so fruitful, has now been undermined to some extent or at least changed since McLaine and Eilenberg developed the notion of categories, that is, sets of elements taken together, with the set of all functions defined on them. As a result, today part of the Bourbaki group is no longer orthodox but is taking into account the more recent notion of categories. So here is another, rather fundamental area of scientific thinking that changed very rapidly.

Let me repeat once again that we cannot say that on the one hand there is the history of scientific thinking, and on the other the body of scientific thought as it is today; there is simply a continual transformation, a continual reorganisation. And this fact seems to me to imply that historical and psychological factors in these changes are of interest in our attempt to understand the nature of scientific knowledge.

[Another opinion, often quoted in philosophical circles, is that the theory of knowledge studies essentially the question of the validity of science, the criteria of this validity and its justification. If we accept this viewpoint, it is then argued that the study of science as it is, as a fact, is fundamentally irrelevant. Genetic epistemology, as we see it, reflects most decidedly this separation of norm and fact, of valuation and description. We believe that, to the contrary, only in the real development of the sciences can we discover the implicit values and norms that guide, inspire and regulate them. Any other attitude, it seems to us, reduces to the rather arbitrary imposition on knowledge of the personal views of an isolated observer. This we want to avoid.]

I should like to give one or two examples of areas in which the genesis of contemporary scientific ideas can be understood better in the light of psychological or sociological factors. The first one is Cantor's development of set theory. Cantor developed this theory on the basis of a very fundamental operation, that of one-to-one correspondence. More specifically, by establishing a one-to-one correspondence between the series of whole numbers and the series of even numbers, we obtain a number that is neither a whole number nor an even number but is the first transfinite cardinal number, aleph zero. This very elementary operation of one-to-one correspondence, then, enabled Cantor to go beyond the finite number series, which was the only one in use up until his time. Now it is interesting to ask where this operation of one-to-one correspondence came from. Cantor did not invent it, in the sense that one invents a radically new construction. He found it in his own thinking; it had already been a part of his mental equipment long before he even turned to mathematics, because the most elementary sort of sociological or psychological observation reveals that one-to-one correspondence is a primitive operation. In all sorts of early societies it is the basis for economic exchange, and in small children we find its roots even before the level of concrete operations. The next question that arises is, what is the nature of this very elementary operation of one-to-one correspondence? And right away we are led to a related question: what is the relationship of one-to-one correspondence to the development of the notion of natural numbers? Does the very widespread presence of the operation of one-to-one correspondence justify the thesis of Russell and Whitehead that number is the class of equivalent classes (equivalent in the sense of one-to-one correspondence among the members of the classes)? Or are the actual numbers based on some other operations in addition to one-to-one correspondence? This is a question that we shall examine in more detail later. It is one very striking instance in which a knowledge of the psychological foundations of a notion has implications for the epistemological understanding of this notion. In studying the development of the notion of number in children we can see whether or not it is based simply on the notion of classes of equivalent classes or whether some other operation is also involved.

I should like to go on now to a second example and to raise the following question: how is it that Einstein was able to give a new operational definition of simultaneity at a distance? How was he
able to criticise the Newtonian notion of universal time without giving rise to a deep crisis within physics? Of course his critique had its roots in experimental findings, such as the Michelson-Morley experiment - that goes without saying. Nonetheless, if this redefinition of the possibility of events to be simultaneous at great distances from each other went against the grain of our logic, there would have been a considerable crisis within physics. We would have had to accept one of two possibilities: either the physical world is not rational, or else human reason is impotent - incapable of grasping external reality. Well, in fact nothing of this sort happened. There was no such upheaval. A few metaphysicians (I apologise to the philosophers present) such as Bergson or Maritain were appalled by this revolution in physics, but for the most part and among scientists themselves it was not a very drastic crisis. Why in fact was it not a crisis? It was not a crisis because simultaneity is not a primitive notion: It is not a primitive concept, and it is not even a primitive perception. I shall go into this subject further later on, but at the moment I should just like to state that our experimental findings have shown that human beings do not perceive simultaneity with any precision. If we look at two objects moving at different speeds, and they stop at the same time, we do not have an adequate perception. that they stopped at the same time. Similarly, when children do not have a very exact idea of what simultaneity is, they do not conceive of it independently of the speed at which objects are travelling. Simultaneity, then, is not a primitive intuition; it is an intellectual construction.

Long before Einstein, Henri Poincare did a great deal of work in analysing the notion of simultaneity and revealing its complexities. His studies took him, in fact, almost to the threshold of discovering relativity. Now if we read his essays on this subject, which, by the way, are all the more interesting when considered in the light of Einstein's later work, we see that his reflections were based almost entirely on psychological arguments. Later on I shall show that the notion of time and the notion of simultaneity are based on the notion of speed, which is a more primitive intuition. So there are all sorts of reasons, psychological reasons, that can explain why the crisis brought about by relativity theory was not a fatal one for physics. Rather, it was readjusting, and one can find the psychological routes for this readjustment as well as the experimental and logical basis. In point of fact, Einstein himself recognised the relevance of psychological factors, and when I had the good chance to meet him for the first time in 1928, he suggested to me that is would be of interest to study the origins in children of notions of time and in particular of notions of simultaneity.

What I have said so far may suggest that it can be helpful to make use of psychological data when we are considering the nature of knowledge. I should like now to say that it is more than helpful; it is indispensable. In fact, all epistemologists refer to psychological factors in their analyses, but for the most part their references to psychology are speculative and are not based on psychological research. I am convinced that all epistemology brings up factual problems as well as formal ones, and once factual problems are encountered, psychological findings become relevant and should be taken into account. The unfortunate thing for psychology is that everybody thinks of himself as a psychologist. This is not true for the field of physics, or for the field of philosophy, but it is unfortunately true for psychology. Every man considers himself a psychologist. As a result, when an epistemologist needs to call on some psychological aspect, he does not refer to psychological research and he does not consult psychologists; he depends on his own reflections. He puts together certain ideas and relationships within his own thinking, in his personal attempt to resolve the psychological problem that has arisen. I should like to cite some instances in epistemology where psychological findings can be pertinent, even though they may seem at first sight far removed from the problem.

My first example concerns the school of logical positivism. Logical positivists have never taken psychology into account in their epistemology, but they affirm that logical beings and mathematical beings are nothing but linguistic structures. That is, when we are doing logic or mathematics, we are simply using general syntax, general semantics, or general pragmatics in the sense of Morris, being in this case a rule of the uses of language in general. The position in general is that logical and mathematical reality is derived from language. Logic and mathematics are nothing but specialised
linguistic structures. Now here it becomes pertinent to examine factual findings. We can look to see whether there is any logical behaviour in children before language develops. We can look to see whether the coordinations of their actions reveal a logic of classes, reveal an ordered system, reveal correspondence structures. If indeed we find logical structures in the coordinations of actions in small children even before the development of language, we are not in a position to say that these logical structures are derived from language. This is a question of fact and should be approached not by speculation but by an experimental methodology with its objective findings.

The first principle of genetic epistemology, then, is this - to take psychology seriously. Taking psychology seriously means that, when a question of psychological fact arises, psychological research should be consulted instead of trying to invent a solution through private speculation.

It is worthwhile pointing out, by the way, that in the field of linguistics itself, since the golden days of logical positivism, the theoretical position has been reversed. Bloomfield in his time adhered completely to the view of the logical positivists, to this linguistic view of logic. But currently, as you know, Chomsky maintains the opposite position. Chomsky asserts, not that logic is based on and derived from language, but, on the contrary, that language is based on logic, on reason, and he even considers this reason to be innate. He is perhaps going too far in maintaining that it is innate; this is once again a question to be decided by referring to facts, to research. It is another problem for the field of psychology to determine. Between the rationalism that Chomsky is defending nowadays (according to which language is based on reason, which is thought to be innate in man) and the linguistic view of the positivists (according to which logic is simply a linguistic convention), there is a whole selection of possible solutions, and the choice among these solutions must be made on the basis of fact, that is, on the basis of psychological research. The problems cannot be resolved by speculation.

I do not want to give the impression that genetic epistemology is based exclusively on psychology. On the contrary, logical formalisation is absolutely essential every time that we can carry out some formalisation; every time that we come upon some completed structure in the course of the development of thought, we make an effort, with the collaboration of logicians or of specialists within the field that we are considering, to formalise this structure. Our hypothesis is that there will be a correspondence between the psychological formation on the one hand, and the formalisation on the other hand. But although we recognise the importance of formalisation in epistemology, we also realize that formalisation cannot be sufficient by itself. We have been attempting to point out areas in which psychological experimentation is indispensable to shed light on certain epistemological problems, but even on its own grounds there are a number of reasons why formalisation can never be sufficient by itself. I should like to discuss three of these reasons.

The first reason is that there are many different logics, and not just a single logic. This means that no single logic is strong enough to support the total construction of human knowledge. But it also means that, when all the different logics are taken together, they are not sufficiently coherent with one another to serve as the foundation for human knowledge. Any one logic, then, is too weak, but all the logics taken together are too rich to enable logic to form a single value basis for knowledge. That is the first reason why formalisation alone is not sufficient.

The second reason is found in Gödel's theorem. It is the fact that there are limits to formalisation. Any consistent system sufficiently rich to contain elementary arithmetic cannot prove its own consistency. So the following questions arise: logic is a formalisation, an axiomatisation of something, but of what exactly? What does logic formalise? This is a considerable problem. There are even two problems here. Any axiomatic system contains the undemonstrable propositions or the axioms, at the outset, from which the other propositions can be demonstrated, and also the undefinable, fundamental notions on the basis of which the other notions can be defined. Now in the case of logic what lies underneath the undemonstrable axioms and the undefinable notions? This is the problem of structuralism in logic, and it is a problem that shows the inadequacy of formalisation as the fundamental basis. It shows the necessity for considering thought itself as well as considering
axiomatised logical systems, since it is from human thought that the logical systems develop and remain still intuitive.

The third reason why formalisation is not enough is that epistemology sets out to explain knowledge as it actually is within the areas of science, and this knowledge is, in fact not purely formal: there are other aspects to it. In this context I should like to quote a logician friend of mine, the late Evert W. Beth. For a very long time he was a strong adversary of psychology in general and the introduction of psychological observations into the field of epistemology, and by that token an adversary of my own work, since my work was based on psychology. Nonetheless, in the interests of an intellectual confrontation, Beth did us the honour of coming to one of our symposia on genetic epistemology and looking more closely at the questions that were concerning us. At the end of the symposium he agreed to co-author with me, in spite of his fear of psychologists, a work that we called Mathematical and Psychological Epistemology. This has appeared in French and is being translated into English. In his conclusion to this volume, Beth wrote as follows: "The problem of epistemology is to explain how real human thought is capable of producing scientific knowledge. In order to do that we must establish a certain coordination between logic and psychology." This declaration does not suggest that psychology ought to interfere directly in logic - that is of course not true - but it does maintain that in epistemology both logic and psychology should be taken into account, since it is important to deal with both the formal aspects and the empirical aspects of human knowledge.

So, in sum, genetic epistemology deals with both the formation and the meaning of knowledge. We can formulate our problem in the following terms: by what means does the human mind go from a state of less sufficient knowledge to a state of higher knowledge? The decision of what is lower or less adequate knowledge, and what is higher knowledge, has of course formal and normative aspects. It is not up to psychologists to determine whether or not a certain state of knowledge is superior to another state. That decision is one for logicians or for specialists within a given realm of science. For instance, in the area of physics, it is up to physicists to decide whether or not a given theory shows some progress over another theory. Our problem, from the point of view of psychology and from the point of view of genetic epistemology, is to explain how the transition is made from a lower level of knowledge to a level that is judged to be higher. The nature of these transitions is a factual question. The transitions are historical or psychological or sometimes even biological, as I shall attempt to show later.

The fundamental hypothesis of genetic epistemology is that there is a parallelism between the progress made in the logical and rational organisation of knowledge and the corresponding formative psychological processes. Well, now, if that is our hypothesis, what will be our field of study? Of course the most fruitful, most obvious field of study would be reconstituting human history - the history of human thinking in prehistoric man. Unfortunately, we are not very well informed about the psychology of Neanderthal man or about the psychology of Homo siniensis of Teilhard de Chardin. Since this field of biogenesis is not available to us, we shall do as biologists do and turn to ontogenesis. Nothing could be more accessible to study than the ontogenesis of these notions. There are children all around us. It is with children that we have the best chance of studying the development of logical knowledge, mathematical knowledge, physical knowledge, and so forth. These are the things that I shall discuss later in the book.

So much for the introduction to this field of study. I should like now to turn to some specifics and to start with the development of logical structures in children. I shall begin by making a distinction between two aspects of thinking that are different, although complementary. One is the figurative aspect, and the other I call the operative aspect. The figurative aspect is an imitation of states taken as momentary and static. In the cognitive area the figurative functions are, above all, perception, imitation, and mental imagery, which is in fact interiorised imitation. The operative aspect of thought deals not with states but with transformations from one state to another. For instance, it includes actions themselves, which transform objects or states, and it also includes the intellectual operations, Which are essentially systems of transformation. They are actions that are comparable to
other actions but are reversible, that is, they can be carried out in both directions (this means that the results of action A can be eliminated by another action B, its inverse: the product of A with B leading to the identity operation, leaving the state unchanged) and are capable of being interiorised; they can be carried out through representation and not through actually being acted out. Now, the figurative aspects are always subordinated to the operative aspects. Any state can be understood only as the result of certain transformations or as the point of departure for other transformations. In other words, to my way of thinking the essential aspect of thought is its operative and not its figurative aspect.

To express the same idea in still another way, I think that human knowledge is essentially active. To know is to assimilate reality into systems of transformations. To know is to transform reality in order to understand how a certain state is brought about. By virtue of this point of view, I find myself opposed to the view of knowledge as a copy, a passive copy, of reality. In point of fact, this notion is based on a vicious circle: in order to make a copy we have to know the model that we are copying, but according to this theory of knowledge the only way to know the model is by copying it, until we are caught in a circle, unable ever to know whether our copy of the model is like the model or not. To my way of thinking, knowing an object does not mean copying it - it means acting upon it. It means constructing systems of transformations that can be carried out on or with this object. Knowing reality means constructing systems of transformations that correspond, more or less adequately, to reality. They are more or less isomorphic to transformations of reality. The transformational structures of which knowledge consists are not copies of the transformations in reality; they are simply possible isomorphic models among which experience can enable us to choose. Knowledge, then, is a system of transformations that become progressively adequate.

It is agreed that logical and mathematical structures are abstract, whereas physical knowledge - the knowledge based on experience in general - is concrete. But let us ask what logical and mathematical knowledge is abstracted from. There are two possibilities. The first is that, when we act upon an object, our knowledge is derived from the object itself. This is the point of view of empiricism in general, and it is valid in the case of experimental or empirical knowledge for the most part. But there is a second possibility: when we are acting upon an object, we can also take into account the action itself, or operation if you will, since the transformation can be carried out mentally. In this hypothesis the abstraction is drawn not from the object that is acted upon, but from the action itself. It seems to me that this is the basis of logical and mathematical abstraction.

In cases involving the physical world the abstraction is abstraction from the objects themselves. A child, for instance, can heft objects in his hands and realize that they have different weights - that usually big things weigh more than little ones, but that sometimes little things weigh more than big ones. All this he finds out experientially, and his knowledge is abstracted from the objects themselves. But I should like to give an example, just as primitive as that one, in which knowledge is abstracted from actions, from the coordination of actions, and not from objects. This example, one we have studied quite thoroughly with many children, was first suggested to me by a mathematician friend who quoted it as the point of departure of his interest in mathematics. When he was a small child, he was counting pebbles one day; he lined them up in a row, counted them from left to right, and got ten. Then, just for fun, he counted them from right to left to see what number he would get, and was astonished that he got ten again. He put the pebbles in a circle and counted them, and once again there were ten. He went around the circle in the other way and got ten again. And no matter how he put the pebbles down, when he counted them, the number came to ten. He discovered here what is known in mathematics as commutativity, that is, the sum is independent of the order. But how did he discover this? Is this commutativity a property of the pebbles? It is true that the pebbles, as it were, let him arrange them in various ways; he could not have done the same thing with drops of water. So in this sense there was a physical aspect to his knowledge. But the order was not in the pebbles; it was he, the subject, who put the pebbles in a line and then in a circle. Moreover, the sum was not in the pebbles themselves; it was he who united them. The knowledge that this future mathematician discovered that day was drawn, then, not from the
physical properties of the pebbles, but from the actions that he carried out on the pebbles. This knowledge is what I call logical mathematical knowledge and not physical knowledge.

The first type of abstraction from objects I shall refer to as simple abstraction, but the second type I shall call reflective abstraction, using this term in a double sense. "Reflective" here has at least two meanings in the psychological field, in addition to the one it has in physics. In its physical sense reflection refers to such a phenomenon as the reflection of a beam of light off one surface onto another surface. In a first psychological sense abstraction is the transposition from one hierarchical level to another level (for instance, from the level of action to the level of operation). In a second psychological sense reflection refers to the mental process of reflection, that is, at the level of thought a reorganisation takes place.

I should like now to make a distinction between two types of actions. On the one hand, there are individual actions such as throwing, pushing, touching, rubbing. It is these individual actions that give rise most of the time to abstraction from objects. This is the simple type of abstraction that I mentioned above. Reflective abstraction, however, is based not on individual actions but on coordinated actions. Actions can be coordinated in a number of different ways. They can be joined together, for instance; we can call this an additive coordination. Or they can succeed each other in a temporal order; we can call this an ordinal or a sequential coordination. There is a before and an after, for instance, in organising actions to attain a goal when certain actions are essential as means to attainment for this goal. Another type of coordination among actions is setting up a correspondence between one action and another. A fourth form is the establishment of intersections among actions. Now all these forms of coordinations have parallels in logical structures, and it is such coordination at the level of action that seems to me to be the basis of logical structures as they develop later in thought. This, in fact, is our hypothesis: that the roots of logical thought are not to be found in language alone, even though language coordinations are important, but are to be found more generally in the coordination of actions, which are the basis of reflective abstraction. For the sake of completeness, we might add that naturally the distinction between individual actions and coordinated ones is only a gradual and not a sharply discontinuous one. Even pushing, touching, or rubbing has a simple type of organisation of smaller subactions.

This is only the beginning of a regressive analysis that could go much further. In genetic epistemology, as in developmental psychology, too, there is never an absolute beginning. We can never get back to the point where we can say, "Here is the very beginning of logical structures." As soon as we start talking about the general coordination of actions, we are going to find ourselves, of course, going even further back into the area of biology. We immediately get into the realm of the coordinations within the nervous system and the neuron network, as discussed by McCulloch and Pitts. And then, if we look for the roots of the logic of the nervous system as discussed by these workers, we have to go back a step further. We find more basic organic coordinations. If we go further still into the realm of comparative biology, we find structures of inclusion ordering correspondence everywhere. I do not intend to go into biology; I just want to carry this regressive analysis back to its beginnings in psychology and to emphasise again that the formation of logical and mathematical structures in human thinking cannot be explained by language alone, but has its roots in the general coordination of actions.

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**Further Reading:** Biography | Construction of Reality (Piaget)
Marxist Psychology & Linguistics | Genetic Psychology (Wallon)
Lektorsky | Vygotsky Archive | Piaget on Vygotsky
Philosophy Archive @ marxists.org

Tot el material propi d'aquesta secció és d'ús públic d'acord amb la Llicència de Documentació Lliure de GNU.

Benvingudes i benvinguts a la secció catalana de l'Arxiu Virtual dels Marxistes.

La secció l'hem dividida en els següents apartats:

**Què és el marxisme? (Introducció al marxisme)**

Enciclopèdia del marxisme

Karl Marx i Friedrich Engels

Lenin

**Autors nascuts entre 1818 i 1847 (Lafargue)**

**Autors nascuts entre 1848 i 1877 (Zetkin, Connolly, Luxemburg, Kollontai, Rakovsky i d'altres)**

**Autors nascuts entre 1878 i 1907 (Trockij, Korsch, Reed, Bordiga, Serge, Gramsci, Nin, Mattick i d'altres)**

**Autors nascuts després de 1938**

Índex alfabètic d'autors

Índex temàtic d'obres

Quant a l'**enciclopèdia del marxisme**, podeu enviar-nos suggeriments i noves definicions mitjançant **aquesta pàgina**.

A l'**Arxiu Virtual dels Marxistes** volem donar un accés fàcil als treballs "clàssics" del marxisme. Ja n'hi ha una part substancial disponible en anglès, i en establir la secció no-anglesa esperem que més gent puga utilitzar l'arxiu.

Aquesta secció catalana és en un procés de continu creixement, i queda molt per fer. Pren el seu temps passar els textes a un mig electrònic. Així si esteu buscant treballs específics que encara no hi
són, si us plau féu un cop d'ull a l'arxiu en llengua anglesa o a les altres seccions lingüístiques (especialment, l'alemanya i la russa).

Podeu contribuir-hi de diferents formes:
- Enviau-nos texts (discursos, conferències, articles, llibres, etc.) d'autors marxistes o d'interès pel moviment obrer, ja siguen originals en català o en altres llengües, o traduccions.
- Enviau-nos les vostres traduccions de texts d'altres llengües al català, i del català a altres llengües.
- Escriu articles (biografies, conceptes, valoracions històriques i d'actualitat) per a la nostra «enciclopèdia del marxisme». Això ho podeu enviar mitjançant aquesta pàgina.
- Feu-nos arribar suggeriments i tota mena de remarques sobre mancances de la secció i de l'arxiu en general.
- Difoneu en paper els texts presents a la secció i a tot l'arxiu.
- Ofereu-vos com a voluntari per a tasques concretes de l'arxiu (Volunteer Workshop).

Per fer tot això n'hi ha prou que us adreçau a l'administrador de la secció.

Els filòsofs tan sols han interpretat món de diferents formes; ara la qüestió és canviar-lo.

(Karl Marx: Tesis sobre Feuerbach)

Darrera actualització: 12.5.2011
Novetats:
12.5: Lar? (1917), de Lev Trockij.
5.5: Stalin (1940), de Lev Trockij.
5.5: Lenin (1924), de Lev Trockij.
2.5: L'origen del Primer de Maig (1894), de Rosa Luxemburg (Edicions Sedov)
25.4: «El matrimonio modern», capítol vuitè de La dona i el socialisme, d’August Bebel.
25.4: El paper dels menxevics i els socialistes-revolucionaris en la Conferència Democràtica (octubre del 1917), de Lev Trockij.
25.4: Discurs en la Conferència Democràtica (setembre del 1917), de Lev Trockij.
25.4: A sang i foc (agost del 1917), de Lev Trockij.
25.4: L’aixecament de juliol (1917), de Lev Trockij.
24.4: Endavant (juny del 1917), de Lev Trockij.

Llocs recomanats:
Universitat Comunista dels Països Catalans.
«Comunista.cat»
«Debat Roig»


Obres escollides de Lenin i de Rosa Luxemburg, d’Edicions Internacionals Sedov.

Textos de formació, a la pàgina web de Revolta Global.

**In Defence of Marxism** i el seu apartat en català.

**Fullets**, a la pàgina web d’en lluita.

Textos sobre socialisme, a la pàgina web del Moviment de Defensa de la Terra.

Textos clàssics i moderns sobre història, política i lluita de classes, a la pàgina web d’**Endavant (OSAN)**.

En defensa del marxisme (Tribuna de la lluita de classes), en línia.

«El Talp»

«Alteritat», pàgina de Rafael Pla López.

«Diccionari de sindicats, sindicalistes i de la història del moviment obrer de Catalunya».

Portal llibertat.cat.

**Indymedia**, i les seues edicions d’Alacant, d’Andorra, de Barcelona, de La Plana i de València.

Fòrum Social Català (FSCat).

La fàbrica (espaí de producció i reproducció d’idees dels Països Catalans)
"Mas o que Importa é Transformar o Mundo!"
MIA: Autores Marxistas

Marxists Internet Archive
SECCION EN ESPAÑOL

Selección de
AUTORES MARXISTAS

A - D

Mijail Bajtin (1895 -1975)
Lingüista, profesor y crítico ruso. Rector de Literatura Rusa y Literatura Mundial en la Universidad Pedagógica de Mordova en Saransk.

Amadeo Bordiga (1889 -1970)

Mieczislaw Bortenstein (1907 - 1942)
Conocido también como "M. Casanova", sirvió en la milicia de la CNT durante la Guerra Civil Española, editó el periódico La Voz Leninista, órgano del grupo Bolchevique-Leninista español, agrupación que paso a dirigir hacia fines de la guerra.

Pierre Broué (1926 - 2005)
Historiador y líder trotskista francés. Participó en la resistencia y murió en el PCF durante la II Guerra Mundial. Luego rompió con ese partido y se adhirió a la IV Internacional. En 1968 fue fundador de la Organization Comuniste Internacionaliste. En los 1980s se dedicó a sus investigaciones y publicó varios libros sobre el movimiento comunista.

James P. Cannon (1890-1974)
Uno de los fundadores del Partido Comunista y luego del trotskismo en los EEUU, fue por un tiempo secretario de Trotsky. En 1938, junto a Max Schachtman y Martin Abern, funda el Socialist Workers Party (SWP) al que sirvió de Secretario Nacional hasta su muerte.

Tony Cliff (1917-2000)
Teórico trotskista palestino. Impulsó la tesis de que la URSS era un régimen capitalista de estado. Fundó y dirigió el Socialist Workers Party de Gran Bretaña. Se opuso a las diversas fracciones de la IV Internacional.

Luis de la Puente Uceda (1926-1965)
Fundador, principal ideólogo y Comandante General del Movimiento de Izquierda Revolucionaria (MIR) peruano. Exponentes de la teoría de focos guerrilleros como catalizadores de la revolución, Uceda y el MIR iniciaron la lucha armada en 1965, la cual es prontamente derrotada por el ejército peruano, cayendo Uceda en combate.

Eugene V. Debs (1855-1926)
Líder sindical, presidente del sindicato ferroviario y dirigente de importantes e históricas huelgas. Fundador del Partido
Nicolás Bujarin (1888-1938)
Revolucionario bolchevique. Editor de *Pravda*. Uno de los dirigentes teóricos del partido, enfocó en materia económica y escribió sobre el socialismo de mercado. Se unió a Stalin contra Trotsky, pero luego dirigió la Oposición de Derecha.

Hal Draper (1914-1990)
Importante miembro a su vez del Partido Socialista y luego del Socialist Workers Party de los EE.UU. Sostuvo que la URSS era estado colectivista burocrático. En 1940 funda el Workers Party.

E - H

Federico Engels (1820-1895)
Co-fundador de la práctica y filosofía del socialismo científico junto a Carlos Marx. Sentó las bases del marxismo a través del examen de la historia, del surgimiento del capitalismo y aguda crítica a otras filosofías. Fundador de la de la Liga Comunista y de la la I Internacional.

Julian Gorkin (1901-1986)
Periodista y comunista. Secretario Internacional del "Bloque Obrero y Campesino" del Partido Obrero de Unificación Marxista (POUM) de España. Luego de la Guerra Civil española, milió en la sección mexicana del POUM en el exilio.

Herman Gorter (1864-1927)
Escritor y poeta holandés, militante del ala izquierda del movimiento obrero, fue adversario de la Primera Guerra Mundial. Fundó el Partido Comunista Laborista, antiparlamentario.

Antonio Gramsci (1891-1937)
Miembro fundador del Partido Comunista italiano. Arrestado en 1926 y condenado por el gobierno fascista a 20 años de prisión. Teorizó sobre conceptos claves como la hegemonía, base y superestructura, intelectuales orgánicos, y guerra de posiciones.

Ted Grant (1913-2006)
Nacido en Sudafrica, fue miembro-fundador y, por largo tiempo dirigente, de la "Tendencia Militante" dentro del Partido Laborista de Gran Bretaña hasta su expulsión en 1983. Hasta su muerte contribuyó a las páginas de *Socialist Appeal* e *In Defense of Marxism*.

Ernesto "Che" Guevara (1928-1967)
Revolucionario internacionalista. Ayudó a crear y mantener el socialismo en Cuba, teorizó sobre nuevas formas de organizar la economía bajo el socialismo. Desarrolló la teoría y estrategia foquista y contribuyó directamente a luchas revolucionarias en África y Sudamérica.

Duncan Hallas (1925-2002)
Hijo de una familia obrera de Manchester se unió al movimiento trostnik cuando aun joven. Participó en la fundación del Socialist Review Group y del Socialismo Internacional. En 1968 se reincorporó a Socialismo Internacional, en cuyas filas milió con distinción.

Schafik Jorge Handal (1930-2006)
Secretario General del Partido Comunista de El Salvador y comandante guerrillero en el Frente Farabundo Martí Para La Liberación Nacional (FMLN) en los 1980s. Luego de los acuerdos de paz, dirigió al FMLN en su transición a partido electoral y fue electo diputado a la Asamblea Nacional.
Liborio Justo (1902-2003)
Conocido también por sus seudónimos literarios de "Quebracho" y "Lobodón Garra," fue un destacado militante trotskista argentino. Abogó por la unificación de los partidarios argentinos de la IV Internacional pero luego rompió con la IV Internacional.

Karl Kautsky (1854-1938)
Amigo de Marx y Engels, ayudó a establecer la Social-Democracia Alemana y fue uno de los principales teóricos de la II Internacional. Durante la I Guerra Mundial devino en pacifista y se opuso al bolchevismo.

Alejandra Kollontai (1872-1952)
Revolucionaria feminista bolchevique. Dirigió la Oposición Obrera que se opuso al control partidario sobre los sindicatos. Promovió el amor libre y escribió acerca de temas sociales y de la mujer.

Nadezhda Krupskaya (1869-1939)
Revolucionaria bolchevique, miembro del gobierno soviético y de la editorial de Iskra. Promovió el Día Internacional de la Mujer en Rusia. También recordada por haber sido la compañera y consejera de V. I. Lenin.

Paul Lafargue (1841-1911)
Médico y socialista francés, autor de varias obras sobre la historia del marxismo y esposo de Laura Marx. Fue fundador del Partido Obrero francés en 1879. Participó en la I Internacional y en la Comuna de París.

Vladimir Lenin (1870-1924)
Miembro fundador, principal teórico y dirigente del partido Bolchevique. Dirigió al partido y los soviets a la toma del poder en la Revolución Rusa. Fundó la Internacional Comunista, identificó al imperialismo como fase nueva del capitalismo y puso énfasis en el partido como vanguardia de la revolución.

Karl Liebknecht (1871-1919)
Miembro de la socialdemocracia alemana desde 1900. Fue el único parlamentario del SPD que se opuso a votar los créditos de guerra. Expulsado del partido y encarcelado por su oposición a la guerra fue. Junto a Rosa Luxemburgo creó el grupo Espartaco y el 1° de enero de 1919 creó el Partido Comunista.

Anatoli Lunacharsky (1875-1933)
Revolucionario bolchevique, gran orador y Comisario de Educación el gobierno soviético. Se abocó por archivar y estudiar la historia rusa, escribiendo apuntes biográficos e ilustrativos de los líderes de la Revolución.

Rosa Luxemburgo (1871-1919)
Promotora de la huelga general como arma de combate clasista, opositora sin tregua a la I Guerra Mundial y crítica de Lenin y los bolcheviques. Separose del Social-Democracia alemana para fundar la Liga Espartaquista y luego el Partido Comunista alemán.

José Carlos Mariátegui (1894 - 1930)
Periodista y escritor indigenista y marxista peruano. Impulsó la fundación de la Confederación General de Trabajadores

Felix Morrow (1906-1988)
Por muchos años una figura importante dentro del trotskismo norteamericano, apreciado por sus escritos sobre España.
del Perú y fundó el Partido Comunista Peruano. Editor de varios periódicos obreros y de la influencial revista *Amauta*.

**Carlos Marighela** (1911-1969)
Dirigente comunista y guerrillero brasileño. Electo a la Asamblea Constituyente de 1946 pero a fines de los 1960s sus críticas a la vía electoralista y urbana del PCB lo llevan a separarse y lanzar la guerrilla de Acción Libertadora Nacional.

**Carlos Marx** (1818-1883)
Co-fundador de la práctica y filosofía del socialismo científico junto a Federico Engels. Sentó las bases del marxismo a través del examen de la historia, del surgimiento del capitalismo y aguda crítica a otras filosofías. Fundador de la Liga Comunista y de la I Internacional.

**Paul Mattick** (1903-1942)
Comunista de izquierda alemán. Luego de una juventud de actividad comunista con los Espartaquistas se mudó a los EEUU, desde donde fue uno de los principales promotores del "comunismo de consejos".

**Joaquin Maurin** (1896-1973)
Periodista, escritor y militante revolucionario español. Teórico de la política de la "Alianza Obrera" y Secretario General del Bloque Obrero-Campesino. Miembro fundador y dirigente del POUM.

**Franz Mehring** (1846 - 1919)
Miembro del ala izquierda del Partido Socialdemócrata Alemán (SPD). Luchó contra el revisionismo en la II Internacional. Durante la I Guerra Mundial atacó la política de cooperación del SPD con el gobierno y se asoció con Rosa Luxemburgo para crear la Liga Espartaco.

**Nahuel Moreno** (1924-1987)
Destacado líder y teórico trotskista argentino. Organizador del Secretariado Latinoamericano del Trotskyismo Ortodoxo (SLATO) y luego de la Liga Internacional de los Trabajadores - Cuarta Internacional

**Ngô Van Xuyet** (1913-2005)

**George Novack** (1905-1992)
Trotskista norteamericano y autor de numerosos libros y artículos sobre filosofía e historia marxistas. Fue miembro de la dirección nacional del SWP.

**Michel Pablo** (1911-1996)
Nacido Michel Raptis, fue Secretario Internacional de la IV Internacional desde los 1940s hasta 1963. Desarrolló la teoría de "siglos de estados obreros deformados", y propugnó la liquidación de partidos trotskistas a cambio de conformar el ala izquierda de partidos stalinistas. Luego fue ministro en el gobierno de Ben Bella en Argelia.

**Anton Pannekoek** (1873-1960)
Socialista y astrónomo holandés. Conformó el ala izquierda de los partidos socialdemócratas holandés y alemán. Alentó al movimiento de consejos obreros, y luego de la división del movimiento comunista, se alineó con su ala antibolchevique.

**Eugenio Preobrazhenski** (1886 -1937)
Miembro del Comité Central del partido bolchevique hasta 1921. Devino principal
Karl Radek (1885-1939)  
Miembro del POSDR desde su juventud, se hizo bolchevique en 1917, luego de la Revolución de Octubre. Ocupó varios cargos en partido y en la Comintern pero acabó víctima de las purgas y murió en prisión en 1939.

Christian Rakovski (1873-1941)  
Presidente del gobierno soviético de Ucrania, trabajó por mantener indentidad soviética ucraniana ante la rusificación. Escribió sobre la economía socialista. Ideólogo de la Oposición de Izquierda a Stalin, fue expulsado del Partido Comunista en 1927. Murió en prisión.

Jorge Abelardo Ramos (1921-1994)  
Historiador argentino. Adopta el marxismo en los años 1930s y, retomando la observación de Trotsky sobre los Estados Unidos Socialistas de América Latina, analiza a fondo la historia latinoamericana y concluye que la única Nación posible al sur del Río Bravo es la Nación Latinoamericana.

Luis Emilio Recabarren (1905-1979)  
Periodista y sindicalista chileno. Participa en la fundacion del Partido Comunista de la Argentina y luego en la fundación del Partido Obrero Socialista de Chile. Bajo su liderazgo el POS evoluciona hacia el bolchevismo, uniendose a la III Internacional y deveniendo en el Partido Comunista de Chile

John Reed (1887-1920)  
Periodista y testigo de presencial de la Revolución Rusa, es expulsado del Partido Socialista de los EE.UU. por radical. Funda el Communist Labor Party y, de vuelta a Rusia, participa en la Comintern y en el Congreso de los

Otto Rühle (1874-1943)  
Comunista de izquierda alemán. Se unió al Partido Socialdemocrata alemán en 1900 y fue miembro del Grupo Espartaquista hasta 1917. Sirvió de presidente del Consejo Obrero de Dresden y de delegado a la fundación del Partido Comunista Alemán.

Mario Roberto Santucho (1936 - 1976)  
Destacado dirigente y organizador del Frente Revolucionario Indoamericano Popular y luego del Partido Revolucionario de los Trabajadores de Argentina y de su brazo militar, el Ejército Revolucionario del Pueblo.

Victor Serge (1890 - 1947)  

Jorge Enea Spilimbergo (1928 - 2004)  
Historiador, periodista y militante argentino. Analizó a fondo la cuestión nacional y el imperialismo en Latinoamérica desde una óptica marxista. Fundó y condujo varios proyectos y periódicos de izquierda, a veces bajo severas condiciones de clandestinidad.
Leon Trotsky (1879-1940)
Primero cercano a los mencheviques y luego bolchevique. Como Comisario de Guerra dirigió al Ejército Rojo a la victoria en la Guerra Civil rusa y sobre la invasión imperialista a la Rusia soviética. Ayudó a crear y luego dirigió la Oposición de Izquierda a Stalin. Desarrolló la teoría de la Revolución Permanente y fundó la IV Internacional.
Los fundadores del Marxismo, Carlos Marx y Federico Engels, habiendo ya fundado la Liga Comunista, participaron en la Asociación Internacional de los Trabajadores de 1864 a 1872. Con sede en Londres, la Internacional tuvo apoyo a lo largo de Europa y los EE.UU., y aglutinó a todas las tendencias radicales del naciente movimiento obrero, juntando hasta a marxistas con anarquistas.

Asociación Internacional de los Trabajadores (Primera Internacional)

Carlos Marx (1818-1883) & Federico Engels (1820-1895)
Fundadores de la práctica y filosofía del socialismo científico. Sentaron las bases del marxismo a través del examen del surgimiento del capitalismo, la historia de la sociedad y la crítica a otras filosofías entonces en boga. Fundadores de la Liga Comunista y de la Asociación Internacional de los Trabajadores, también conocida como la Primera Internacional.

Eleanor Marx (1855-1898)
Hija de Carlos Marx, activista y autora

Paul Lafargue (1841-1911)
Médico y socialista francés, autor de varias
Marxista. Sirvió de secretaria a su padre y luego se desempeñó como profesora. Organizó sindicatos y apoyó huelgas. Fue fundadora de la Liga Socialista.

Ver también: Mikhail Bakunin, Jenny von Westphalen

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**Segunda Internacional**

A partir de los 1880s, movimientos obreros militantes surgieron en todos los países industrializados. Sobre esa base, los marxistas lograron construir poderosos partidos social-democratas que dotaron de dirigencia política a aquellos movimientos y transformaron al marxismo en un movimiento de alcance mundial. Aunque se dividió a raíz de la I Guerra Mundial, perdiendo su ala radical, la II Internacional persistió en forma rudimentaria. Después de la II Guerra Mundial fue refundada como Internacional Socialista y algunos de sus partidos han, incluso, alcanzado el poder por vías electorales.

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**Karl Kautsky** (1854-1938)
Amigo de Marx y Engels, ayudó a establecer la Social-Democracia Alemana y fue uno de los principales teóricos de la II Internacional. Durante la I Guerra Mundial devino en pacifista y se opuso al bolchevismo.

**Eugene V. Debs** (1855-1926)
Líder sindical, presidente del sindicato ferroviario y dirigente de importantes e históricas huelgas. Fundador del Partido Socialista de los Estados Unidos y varias veces su candidato para presidente del país.

**Antonio Labriola** (1843-1904)
Filósofo italiano, masón, catedrático universitario y teórico marxista. Aunque nunca se afilió ningún partido político su pensamiento influyó a muchos teóricos políticos italianos de principios del siglo XX.

**Liga Espartaco**

**Rosa Luxemburgo** (1871-1919)
Promotora de la huelga general como arma de combate clasista, opositora sin tregua a la I Guerra Mundial y crítica de Lenin y los bolcheviques. Separose del Social-Democracia alemana para fundar la Liga Espartaquista y luego el Partido Comunista alemán.

**Karl Liebknecht** (1871-1919)
Miembro de la socialdemocracia alemana desde 1900. Fue el único parlamentario del SPD que se opuso a votar los créditos de guerra. Expulsado del partido y encarcelado por su oposición a la guerra fue. Junto a Rosa Luxemburgo creó el grupo Espartaco y el 1° de enero de 1919 creó el Partido Comunista.

**Franz Mehring** (1846 - 1919)
Miembro del ala izquierda del Partido
Helmut Wagner (1904 - 1989)
Periodista y pedagogo Social-demócrata de izquierda, y miembro de la agrupación alemana Rote Kämpfer en los años 30s. También conocido por su nombre de pluma, Rudolf Sprenger.

Menchevismo

Georgi Plejánov (1856 - 1918)
A través de sus polémicas con los revolucionarios de Naródnaya Volya, el populismo, el terrorismo, y con los anarquistas y los liberales, Plejánov difundió el marxismo en Rusia y contribuyó al desarrollo de muchas ideas marxistas en el área de la filosofía.

Ver también: Leon Trotsky

Contemporaneos a la II Internacional

Dov Ber Borojov (1881 - 1917)
Teórico del Sionismo Laborista. Su ideología era una mezcla de sionismo y marxismo. Opinaba que la visión tradicional marxista es válida en los países centrales, mientras que en los países periféricos, el desarrollo de la conciencia nacional acompañaría el de la conciencia social, y que los judíos no podrían tener un estructura de clases normal sin una patria propia.

Ver también: Paul Lafargue, Vladimir Lenin, Leon Trotsky

Los Bolcheviques
La Socialdemocracia no pudo evitar la I Guerra Mundial y con el estallido bélico muchas de sus secciones se alinearon detrás de sus banderas nacionales. Sólo una sección se negó a ello y logró aprovechar de la crisis provocada por la guerra para hacer la revolución: el Partido Bolchevique en Rusia. En 1917 los bolcheviques participaron en las revoluciones que derrocarían primero a la monarquía y luego al régimen burgués, sacando a Rusia de la guerra e instaurando el socialismo por primera vez en la tierra.

Vladimir Lenin (1870-1924)
Miembro fundador, principal teórico y dirigente del partido Bolchevique. Dirigió al partido y los soviets a la toma del poder en la Revolución Rusa. Fundó la Internacional Comunista, identificó al imperialismo como fase nueva del capitalismo y puso emfasis en el partido como vanguardia de la revolución.

Alejandra Kollontai (1872-1952)
Revolucionaria feminista bolchevique. Dirigió la Oposición Obrera que se opuso al control partidario sobre los sindicatos. Promovió el amor libre y escribió acerca de temas sociales y de la mujer.

Nadezhda Krupskaya (1869-1939)
Revolucionaria bolchevique, miembra del gobierno soviético y de la editorial de Iskra. Promovió el Día Internacional de la Mujer en Rusia. También recordada por haber sido la compañera y consejera de V. I. Lenin.

Christian Rakovsky (1873-1941)
Presidente del gobierno soviético de Ucrania, trabajó por mantener indentidad soviética ucraniana ante la rusificación. Escribió sobre la economía socialista. Ideólogo de la Oposición de Izquierda a Stalin, fue expulsado del Partido Comunista en 1927. Murió en prisión.

Anatoli Lunacharsky (1875-1933)
Revolucionario bolchevique, gran orador y Comisario de Educación el gobierno soviético. Se abocó por archivar y estudiar la historia rusa, escribiendo apuntes biográficos e ilustrativos de los líderes de la Revolución.

Leon Trotsky (1879-1940)
Primero cercano a los mencheviques y luego bolchevique. Como Comisario de Guerra dirigió al Ejército Rojo a la victoria en la Guerra Civil rusa y sobre la invasión imperialista a la Rusia soviética. Ayudó a crear y luego dirigió la Oposición de Izquierda a Stalin. Desarrolló la teoría de la Revolución Permanente y fundó la IV Internacional.

Karl Radek (1885-1939)
Miembro del POSDR desde su juventud, se hizo bolchevique en 1917, luego de la Revolución de Octubre. Ocupó varios cargos en partido y en la Comintern pero acabó víctima de las purgas y murió en prisión en 1939.

Nicolás Bujarin (1888-1938)
Revolucionario bolchevique. Editor de Pravda. Uno de los dirigentes teóricos del partido, enfocó en materia económica y escribió sobre el socialismo de mercado. Se unió a Stalin contra Trotsky, pero luego dirigió la Oposición de Derecha.

Eugenio Preobrazhenski (1886-1937)
Miembro del Comité Central del partido bolchevique hasta 1921. Devino principal economista de la Oposición de Izquierda. Murió fusilado por el régimen stalinista en 1937.

Elisaveta Drabkina (1901 - 1974) Miembra del partido bolchevique desde temprana edad, cumplió misiones militares y administrativas durante la Revolución Rusa. Luego en su vida publicaría sus recuerdos de esa época.

Osip Piatnitsky (1882 - 1938) Antiguo bolchevique, cumplió misiones en diversas
partes de Rusia y colaboró con Lenin en introducir clandestinamente material propagandístico. Más tarde ocupó altos puestos en la Comintern. Se opuso abiertamente a Stalin, lo cual le costó la vida.

Ver también: J. V. Stalin

La Tercera Internacional (Comintern)

En 1919 los bolcheviques auspiciaron una conferencia concurrida por revolucionarios de diversos rincones del mundo en la cual se fundó una nueva agrupación internacional revolucionaria, la Internacional Comunista or Comintern. La mayoría de los Partidos Comunistas al rededor del mundo se afilió a la Comintern, la cual duró hasta 1943. Ocupó su lugar un Buro de Información de los Partidos Comunistas y Obreros (Cominform) hasta 1956. Desde entonces, hasta la caída de la Unión Soviética, los Partidos Comunistas y partidos obreros de la Comintern mantuvieron contacto por medio de conferencias y foros patrocinados por la URSS. Algunos, empero, deslindaron con la dirigencia post-Stalin de la URSS, categorizandola de "revisionista".

John Reed (1887-1920)
Periodista y testigo de presencial de la Revolución Rusa, es expulsado del Partido Socialista de los EE.UU. por radical. Funda el Communist Labor Party y, de vuelta a Rusia, participa en la Comintern y en el Congreso de los Pueblos de Oriente en Bakú. Al morir fue sepultado en el Kremlin.

Antonio Gramsci (1891-1937)
Miembro fundador del Partido Comunista italiano. Arrestado en 1926 y condenado por el gobierno fascista a 20 años de prisión. Teorizó sobre conceptos claves como la hegemonía, base y superestructura, intelectuales orgánicos, y guerra de posiciones.

Victor Serge (1890 - 1947)

Andreu Nin (1892-1937)
Destacado miembro de la Oposición de Izquierda y fundador y secretario general del POUM durante la Guerra Civil española. Sus desacuerdos con Trotsky no lo salvaron de ser detenido, asesinado y desaparecido por agentess de Stalin.
**Jorge Dimitrov** (1882-1949)
Dirigente Comunista bulgaro. Fue el último presidente de la Comintern, y dirigió la lucha anti-Nazi en Bulgaria, donde fue electo Primer Ministro de la nueva república socialista en 1945.

Ver también: **Los Bolcheviques**

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**Partido Comunista de la Unión Soviética**

**J. V. Stalin** (1879 - 1953)
Secretario General del Partido Comunista de la URSS desde 1922 hasta su muerte en 1953. Figura controvertida, en serie de purgas eliminó toda la cupula bolchevique responsable por la Revolución, y lideró a la vez la consolidación de burocratismo en la URSS y la resistencia al imperialismo.

Ver también: **Alexei Fiodorov, Leon Trotsky**

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**Partidos Comunistas y Obreros "Oficiales"**

**José Carlos Mariátegui** (1894 - 1930)
Periodista, escritor y teórico indigenista y marxista peruano. Impulsó la fundación de la Confederación General de Trabajadores del Perú y fundó el Partido Socialista Peruano (que luego devino Partido Comunista). Editó varios periódicos obreros y la influencial revista **Amauta**. Se le considera el fundador del marxismo en el Perú.

**Kim Il Sung** (1912 - 1994)
Secretario General del Partido de los Trabajadores de Corea y jefe de estado de la República Democrática Popular de Corea.

**Erich Honecker** (1912 - 1994)
Político alemán, jefe de estado de la República Democrática Alemana entre 1976 y 1989. Se opuso a la Perestroika de Mijaíl Gorbachov, y fue sorprendido por los acontecimientos que llevaron a la caída del Muro de Berlín a finales de 1989.

**Enrique Lister** (1907 - 1994)
Político y militar español. Durante la Guerra Civil comandó tropas en varios combates, incluso la Batalla de Madrid. Exiliado en la URSS durante la II Guerra Mundial, alcanzó el grado de general en las fuerzas soviéticas, de Polonia y de la nueva Yugoslavia. Luego rompe con el PCE y funda el Partido
Instrucción Pública de la República Española durante la Guerra Civil (1936-1939). Posteriormente fue expulsado del PCE y adherido a la tendencia proyugoslava.

**Dolores Ibárruri** (1895-1989)
Miembro del PCE y por largo tiempo Secretaria General de ese partido. Se hizo famosa como una incendiaria oradora y agitadora por el PCE y los republicanos durante la Guerra Civil en España, cuando se le conoció como "La Pasionaria".

**José Díaz** (1896-1942)
Comunista español y Secretario General del PCE. Durante la guerra civil centra su actividad en el partido, priorizando la absoluta victoria militar como objetivo principal, y se opone a diversas medidas revolucionarias tomadas en las fábricas y el campo, mediante las colectivizaciones y las milicias.

**Ho Chi Minh** (1890-1969)
Por largo tiempo líder del Partido Comunista de Vietnam y del movimiento por la liberación nacional vietnamita. Estableció bases guerrilleras en el campo en 1944, pasando a derrotar a los franceses en 1954. Falleció antes de la victoria final sobre los EEUU en 1974.

**Álvaro Cunhal** (1913-2005)

**Palmiro Togliatti** (1893 - 1964)
Miembro-fundador y luego dirigente del Partido Comunista de Italia. Llevó al partido a emplear exclusivamente la vía electoral, y bajo su tutela el PCI devino el segundo partido mas grande de Italia y el PC no-gobernante mas grande en Europa.

**Comunista Obrero Español (PCOE).**

**Pedro Saad** (1909 - 1982)
Político y organizador comunista y sindicalista ecuatoriano. Secretario General del Partido Comunista del Ecuador, fundador y Secretario General de la Confederación de Trabajadores del Ecuador. Diputado a la Asamblea Nacional Constituyente de 1944 y luego Senador Funcional por los obreros del litoral.

**Tránsito Amaguaña** (1909 - 2009)
Militante campesina indígena quichua del Ecuador. Miembro del Partido Comunista del Ecuador y miembro fundadora de la Federación Ecuatoriana de Indios y de la Alianza Femenina Ecuatoriana. Tuvo un rol protagónico en multiples luchas de los campesinos e indígenas de la sierra ecuatoriana.

**Mabendra Nath Roy** (1887 - 1954)
Político y organizador comunista Indio. Participo en la fundacion del Partido Comunista de Mexico y represento a aquel partido ante la Comintern. Luego fue fundador del Partido Comunista de la India en el exilio y formo parte de la delegacion de la Comintern a la China.

**Evelyn Trent** (1892 - 1970)
Politica y organizadora comunista norteamericana. Participo en la fundacion del Partido Comunista de Mexico y represento a aquel partido ante la Comintern. Luego ayudo a fundar el Partido Comunista de la India en el exilio.

Ver tambien: Schafick Handal, Che Guevara, Ho Chi Mihn, Amadeo Bordiga
"Anti-Revisionistas"

Enver Hoxha (1908-1985)
Secretario General del Partido del Trabajo de Albania y jefe de estado Comunista de ese país. Mayormente recordado por sus polemicas con el liderazgo post-Stalin de la URSS y con el Partido Comunista de China.

Bill Bland (1916 - 2001)
Fundador y teorico de la Liga Comunista de Gran Bretaña. Se opuso a ambos, la línea post-Stalin del PCUS y al maoísmo. Enarboló a la Albania de Enver Hoxha como único país socialista restante a partir de los años 1960s.

Saturnino Paredes Macedo
Abogado y profesor peruano. Dirigió la Confederación Campesina del Perú y lideró la escisión de la fracción "pekinesa" del Partido Comunista Peruano, estableciendo "Bandera Roja", uno de los primeros partidos maoístas en el Perú. Luego acaba en el campo pro-Albanés.

Ver tambien: Mao Zedong y Maoísmo

Oposición de Izquierda

Ver: Andreu Nin, Christian Rakovsky, Leon Trotsky y Trotskismo

Autores Soviéticos

Los escritores -ya sean científicos, filosofos, politicos, u otros- en la Union Sovietica y los países en su orbita se vieron obligados a desarrollar sus ideas dentro de esquemas y dogmas oficiales. A pesar de desenvolverse dentro de un sistema normativamente socialista, a estos autores no se les puede automaticamente clasificar como marxistas, pero por ese mismo contexto especial tampoco se les puede necesariamente hacer equivaler a sus similares en países capitalistas.
Alexéi Fiódorov (1901 - 1989)
Dirigente en el movimiento guerrillero anti-Nazi en Ucrania y Belarus durante la II Guerra Mundial, dos veces condecorado Héroe de la URSS. Luego fue jefe de varias dependencias del Partido Comunista y del gobierno soviético ucraniano.

Mijail Bajtin (1895 -1975)
Lingüista, profesor y crítico ruso. Rector de Literatura Rusa y Literatura Mundial en la Universidad Pedagógica de Mordova en Saransk.

Trotskismo
Luego del "Tercer Periodo" en Rusia y del triunfo de Hitler en Alemania, Leon Trotsky y sus simpatizantes, organizados en la Oposición Internacional de Izquierda de la Comintern, llegaron a la conclusión de que la III Internacional estaba acabada como agrupación revolucionaria. En 1938, en Paris, establecieron la IV Internacional, basando su programa y modelo organizativo en los cuatro primeros congresos de la Comintern y en la teoría de Trotsky de "Revolución Permanente". Con el advenimiento de la IV Internacional el Trotskismo cobró fuerza, tornándose en una importante -aunque generalmente pequeña- alternativa dentro los movimientos comunistas y obreros en todo el mundo.

Mieczslaw Bortenstein (1907 - 1942)
Conocido también como "M. Casanova", sirvió en la milicia de la CNT durante la Guerra Civil Española, editó el periódico La Voz Leninista, órgano del grupo Bolchevique-Leninista español, agrupación que paso a dirigir hacia fines de la guerra.

James P. Cannon (1890-1974)
Uno de los fundadores del Partido Comunista y luego del trotskismo en los EEUU, fue por un tiempo secretario de Trotsky. En 1938, junto a Max Schachtman y Martin Abern, funda el Socialist Workers Party (SWP) al que sirvió de Secretario Nacional hasta su muerte.

George Novack (1905-1992)
Trotskista norteamericano y autor de

Ted Grant (1913-2006)
Nacido en Sudafrica, fue miembro-fundador y, por largo tiempo dirigente, de la "Tendencia Militante" dentro del Partido Laborista de Gran Bretaña hasta su expulsión en 1983. Hasta su muerte contribuyó a las páginas de Socialist Appeal e In Defense of Marxism.

Nahuel Moreno (1924-1987)
Destacado líder y teórico trotskita argentino. Organizador del Secretariado Latinoamericano del Trotskismo Ortodoxo (SLATO) y luego de la Liga Internacional de los Trabajadores - Cuarta Internacional (LIT-CI).

Ngó Van Xuyet (1913-2005)
Trotskista vietnamita, fue miembro de la Liga de Comunistas Internacionalistas por la Cuarta Internacional, editora del periódico Le
numerosos libros y artículos sobre filosofía e historia marxistas. Fue miembro de la dirección nacional del SWP.

**Felix Morrow** (1906-1988)
Por muchos años una figura importante dentro del trotskismo norteamericano, apreciado por sus escritos sobre España. Sirvió de editor de *The Militant*, el periódico del Socialist Workers Party, y de su órgano teórico, *Fourth International*.

**Michel Pablo** (1911-1996)
Nacido Michel Raptis, fue Secretario Internacional de la IV Internacional desde los 1940s hasta 1963. Desarrolló la teoría de "siglos de estados obreros deformados", y propugnó la liquidación de partidos trotskistas a cambio de conformar el ala izquierda de partidos stalinistas. Luego fue ministro en el gobierno de Ben Bella en Argelia.

**Pierre Broué** (1926 - 2005)
Historiador y líder trotskista francés. Participó en la resistencia y murió en el PCF durante la II Guerra Mundial. Luego rompió con ese partido y se adhirió a la IV Internacional. En 1968 fue fundador de la Organization Comuniste Internacionaliste. En los 1980s se dedicó a sus investigaciones y publicó varios libros sobre el movimiento comunista.

**Liborio Justo** (1902-2003)
Conocido también por sus seudónimos literarios de "Quebracho" y "Lobodón Garra," fue un destacado militante trotskista argentino. Abogó por la unificación de los partidarios argentinos de la IV Internacional pero luego rompió con la IV Internacional.

**Joaquín Maurín** (1896-1973)
Periodista, escritor y militar revolucionario español. Teorico de la política de la "Alianza Obrera" y Secretario General del Bloque Obrero-Campesino. Miembro fundador y dirigente del POUM.

**Julián Gorkin** (1901-1987)

**Ta Thu Thâu** (1906-1945)
Dirigente de la Cuarta Internacional en Vietnam. Formó el Grupo Bolchevique-Leninista Indochino, el cual publicó los órganos *La Lutte* (La Lucha) y *La Verité* (La Verdad).

**Rudolf Klement** (1908-1938)
Miembro del secretariado Internacional, fue secretario de Trotsky en Turquía y en Francia. En 1938 era secretario del comité que preparaba la Conferencia de fundación de la Cuarta Internacional. Asesinado por la GPU en París en 1938, poco antes de la conferencia.

**Tony Cliff** (1917-2000)
Teórico trotskista palestino. Impulsó la tesis de que la URSS era un régimen capitalista de estado. Fundó y dirigió el Socialist Workers Party de Gran Bretaña. Se opuso a las diversas fracciones de la IV Internacional.

**Duncan Hallas** (1925-2002)
Hijo de una familia obrera de Manchester se unió al movimiento trostskista cuando aun joven. Participo en la fundacion del Socialist Review Group y del Socialismo Internacional. En 1968 se reincorporó a Socialismo Internacional, en cuyas filas miltió con distinción.

**Ernest Mandel** (1923-1995)
Economista, historiador y político belga. Fue uno de los líderes del trotskismo después de la muerte de Trotsky. Fomentó la reunificación del movimiento trotskista internacional y fue uno de los más destacados dirigentes del Partido Obrero Socialista belga. Es considerado uno de los teóricos marxistas más importantes de la segunda mitad del siglo XX.

**Daniel Bensaïd** (1946-2010)
Trotskista francés. Fue líder estudiantil en Mayo de ‘68 y luego dirigente de la agrupación LCR y mas recientemente de la NPA. Se le
director de su periódico a los 17 años. Luego es expulsado del PCE y se une al "Bloque Obrero y Campesino" del Partido Obrero de Unificación Marxista (POUM) de España, donde fue Secretario Internacional.

Chris Harman (1942-2009)
Periodista, escritor y militante británico. Teórico de la corriente Internacional Socialism, miembro del CC del SWP de Gran Bretaña, y editor de Socialist Worker y de International Socialism Journal.

Nicola di Bartolomeo (1902-1946)
Fundador y Secretario Nacional del Partido Operaio Comunista, sección italiana de la IV Internacional. Fue militante comunista, bajo los seudónimos de Fosco y Roland, por más de dos décadas en varios países europeos y combatió en la guerra civil en España.

Ver también: Leon Trotsky, Hal Draper, Evelyn Reed, Daniel Guérin

Maoísmo
A mediados del Siglo XX surge en China una nueva variante ideológica del comunismo que contraria a las formas "clasicas" identificaba en países semicoloniales y semifeudales, como China, no al proletariado urbano, sino al campesinado como la principal fuerza revolucionaria bajo el liderazgo del Partido Comunista. Tenía, además, una doctrina militar integral, propugnando la "guerra popular prolongada", siendo uno de sus aforismos principales que "el poder nace del fusil." El PC Chino tildó a la dirigencia post-Stalín de la URSS de "revisionista" y le disputó el liderazgo entre los partidos y movimientos de la ex-Comintern, ganado adeptos en todos los continentes habitados.

Mao Zedong (1893-1976)

Zhu De (1886-1976)
Dirigente militar en el Partido Comunista de China por muchos años. Fue criticado durante la Grán Revolución Cultural Proletaria, pero

Natalia Sedova (1826-1962)
Revolucionaria rusa, segunda esposa de Trotsk y luego su viuda. Criticó del eventual camino seguido por la IV Internacional.

Guillermo Lora (1922-2009)
Trotskista boliviano. Fue dirigente y principal teórico del Partido Obrero Revolucionario (POR) de Bolivia, y el principal historiador del movimiento obrero de su país.
Luego fue el jefe máximo de la república china hasta su muerte. Sus escritos sobre guerra popular tuvieron gran repercusión internacional.

**Zhou Enlai** (1898-1976)
Fundador de la rama en Europa del Partido Comunista de China y veterano de las guerras contra el Kuomintang y los invasores japoneses. Sirvió de Premier de la República Popular China desde su fundación en 1949.

**Lin Biao** (1907-1971)
Veterano de las guerras contra el Kuomintang y los invasores japoneses, sirvió en el Buro Político del PCCh en el puesto de Vice-Presidente, y también como Ministro de Defensa de la República Popular China.

**Zhang Chunqiao** (1917-2005)
Jefe de propaganda de Shanghai y miembro del Comité Central del Partido Comunista de China. Se alineó con Jian Qing en la célebre "Banda de los Cuatro," por lo cual fue arrestado y condenado después de la muerte de Mao.

**Wang Hongwen** (1935-1992)
Guardia Rojo, miembro del Politiburo y Vicepresident del Partido Comunista de China. Durante la Revolución Cultural se alió con Zhang Chunqiao y Jian Qing. Posteriormente fue condenado a cadena perpetua junto al resto de la "Banda de los Cuatro".

**Chen Boda** (1904-1989)
Secretario político de Mao en Yenán. Fue uno de los impulsores del Movimiento de Rectificación en 1941 y director de *Hongqi*. Devino prácticamente vocero e intérprete oficial de Mao, siendo él el recopilador del *Libro de Rojo*. En 1966 un editorial suyo en *Renmin Ribao* marcó el comienzo de la Revolución Cultural.

luego fue absuelto y rehabilitado.

**Deng Xiaoping** (1904-1997)
Veterano de las guerra revolucionaria y de la Larga Marcha, fue expulsado del PCCh y dos veces rehabilitado. Dirigió la República Popular China después de la muerte de Mao, iniciando cambios socio-económicos que han sido tildados por algunos de restauración del capitalismo.

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**Antonio Díaz Martínez** (1933 -1986)
Ingeniero agrónomo y sociólogo rural peruano. Fue miembro del Partido Comunista del Perú que se conoce como 'Sendero Luminoso', y como tal participó en planificar e iniciar una "guerra popular prolongada" en el Perú.

**Vinod Mishra** (1947 -1998)
Secretario General del Partido Comunista de la India (Marxista-Leninista). Durante más de una década en la clandestinidad en Bihar, Uttar Pradesh, Delhi y Bengala Occidental, reorganizó los órganos del partido y participó en lucha armada.

Ver también: Catalina Adrianzen, Saturnino Paredes
Marxismo Occidental

Marxismo Occidental es un término usado para describir una colección un tanto heterogénea de teóricos del marxismo en Europa y Norteamérica cuyos análisis contrastan con la filosofía predominante en la URSS. Algunos ponen énfasis en los aspectos Hegelianos y humanísticos del pensamiento de Marx, mientras que otros son estructuralistas. Aunque muchos de sus teóricos soslayan análisis económicos, en su conjunto han contribuido a la comprensión de conceptos, como base y superestructura, a veces poco detallados por Marx y Engels.

Hal Draper (1914-1990)
Importante miembro a su vez del Partido Socialista y luego del Socialist Workers Party de los EE.UU. Sostuvo que la URSS era estado colectivista burocrático. En 1940 funda el Workers Party.

Ernst Bloch (1985-1977)
Filósofo alemán y catedrático universitario. Se formó en Alemania y Estados Unidos. Luego de la II Guerra Mundial volvió a Alemania Oriental pero desacuerdos con el partido gobernante lo forzaron a la Alemania Occidental.

La Escuela de Frankfurt

Theodor Adorno (1903-1969)
Filósofo alemán interesado además en la sociología, psicología y musicología. Mezcló el marxismo con influencias tan variadas como Schopenhauer, Dilthey, Nietzsche y Freud. Colaborador de Max Horkheimer.

Max Horkheimer (1895-1973)
Filósofo e investigador social alemán. Dirigió el Instituto de Investigaciones Sociales de Frankfurt 1930-1958; colaborador de Theodor Adorno.

Comunismo de Izquierda
La Izquierda Comunista está formada por grupos que expresan un conjunto de puntos de vista económicamente y políticamente comunistas pero opuestos a los bolcheviques desde una posición que afirma ser más auténticamente marxista y proletaria que las del leninismo sostenido por la URSS y la Comintern después de sus primeros dos congresos. Todos los comunistas de izquierda apoyaron la Revolución de Octubre en Rusia, pero conservaron una visión crítica de su desarrollo, llegando algunos a afirmar que sólo había realizado las tareas de la revolución burguesa, hasta entonces inconclusa, creando un sistema capitalista de estado. No se le debe confundir con la Oposición de Izquierda.

**Herman Gorter** (1864-1927)
Escriptor y poeta holandés, militante del ala izquierda del movimiento obrero, fue adversario de la Primera Guerra Mundial. Fundó el Partido Comunista Laborista, antiparlamentario.

**Amadeo Bordiga** (1889-1970)
Dirigente y teórico comunista italiano. Participó en la fundación del Soviet de Napoles en 1918. Miembro del ala izquierda del Partido Socialista Italiano y luego miembro fundador y principal teórico del Partido Comunista.

**Anton Pannekoek** (1873-1960)
Socialista y astrónomo holandés. Conformó el ala izquierda de los partidos socialdemócratas holandeses y alemán. Alentó al movimiento de consejos obreros, y luego de la división del movimiento comunista, se alineó con su ala anti-bolchevique.

**Paul Mattick** (1903-1942)
Comunista de izquierda alemán. Luego de una juventud de actividad comunista con los Espartaquistas se mudó a los EEUU, donde fue uno de los principales promotores del "comunismo de consejos".

**Otto Rühle** (1874-1943)
Comunista de izquierda alemán. Se unió al Partido Socialdemócrata alemán en 1900 y fue miembro del Grupo Espartaquista hasta 1917. Sirvió de presidente del Consejo Obrero de Dresden y de delegado a la fundación del Partido Comunista Alemán.

**Guy Aldred** (1886-1963)
Comunista libertario, fundador de varios grupos comunistas y anarquistas en Glasgow - Escocia. Apoyó la Revolución de Octubre pero evolucionó a una postura crítica del régimen soviético, acercándose ideológicamente a los Comunistas de Consejos.

**Franz Pfempfert** (1879-1954)
Periodista, político, crítico de literatura, retratista y, desde 1911 a 1932, editor de la revista Die Aktion. Inicialmente, salió en la revolución de Octubre y apoyó la formación de la Liga Espartaco hasta la burocratización del KPD.
## Izquierdas Latinoamericanas

Pensadores y militantes quienes combinaron ideas desarrolladas en sus contextos nacionales latinoamericanos (indigenismo, bolivarismo, antigamonalismo, peronismo, etc) con perspectivas socialistas e inclusive del marxismo, aunque manteniéndose un tanto al margen de las controversias que fracccionaron al movimiento comunista a nivel internacional, para desarrollar proyectos y análisis autóctonos.

### Socialistas

**Salvador Allende** (1908-1973)
Miembro del Partido Socialista de Chile, por el cual fue senador y perenne candidato a la presidencia de la república, la cual alcanzó en 1970. Su gobierno fue víctima de un feroz golpe militar, durante el cual él murió defendiendo el régimen constitucional.

**Jorge Abelardo Ramos** (1921-1994)
Historiador argentino. Adopta el marxismo en los años 1930s y, retomando la observación de Trotsky sobre los Estados Unidos Socialistas de América Latina, analiza a fondo la historia latinoamericana y concluye que la única Nación posible al sur del Río Bravo es la Nación Latinoamericana.

**John William Cooke** (1920-1968)
Abogado, profesor y diputado argentino. Establece una fracción de izquierda dentro del Peronismo y fue uno de los primeros en apoyar a la revolución cubana. Establece contactos con el Che, y es uno de los organizadores de las primeras guerrillas argentinas, los "Uturncos".

**Enrique Rivera** (1922-1995)
Contribuyó al forjamiento de las bases teóricas y políticas de la Izquierda Nacional argentina. Fue autor de innumerables artículos periodísticos y de varios libros.

**Jorge Enea Spilimbergo** (1928 - 2004)
Historiador, periodista y militante argentino. Analizó a fondo la cuestión nacional y el imperialismo en Latinoamérica desde una óptica marxista. Fundó y condujo varios proyectos y periódicos de izquierda, a veces bajo severas condiciones de clandestinidad.

### Populistas

**Víctor Raúl Haya de la Torre** (1895 - 1979)
Abogado, pensador y político peruano. Fundador y líder histórico de la Alianza Popular Revolucionaria Americana (APRA) y del Partido Aprista Peruano, intentó sostener una postura a la vez anti-imperialista y anti-comunista.

### Movimientos Indigenas

Ver: [Tránsito Amaguaña](#)
Ver tambien: M. González Prada, J. C. Mariategui, Lucha Armada

Liberación Nacional y Anticolonialismo

Yasser Arafat (1929-2004)  

José Miguel Beñaran (1869-1939)  
Conocido también como "Argala", fue uno de los hombres más destacados en la historia del movimiento de liberación nacional vasco. Participó activamente en la evolución y reestructuración de la organización armada, Euskadi ta Askatasuna, más conocida como ETA.

Martin Luther King, Jr. (1929-1968)  
Pastor en la iglesia bautista, pacifista y activista del Movimiento por los Derechos Civiles en Estados Unidos para los afroamericanos laureado con el Premio Nobel de la Paz. Organizó y llevó a cabo marchas por el derecho al voto, la no discriminación, y otros derechos civiles básicos.

Thomas Sankara (1949-1987)  
Militar y presidente revolucionario de Burkina Faso. Se autodescribió como inspirado por Fidel Castro y Che Guevara de Cuba y Jerry Rawlings de Ghana. Combatió la corrupción y los tradicionales privilegios de las élites tribales, y mejoró la educación, la agricultura y el estatus de la mujer. Fue asesinado en un golpe de estado apoyado por Francia.

Jawaharlal Nehru (1889-1964)  
Colaborador de Gandhi, primer ministro de la India cuando ésta obtuvo su independencia en 1947 y participó en la fundación del Movimiento de Paises No-Alineados. Propuso el socialismo como solución a los problemas de la India.

Balawant Gangadhar Tilak (1856-1920)  
Nacionalista indio, reformista social, y estudioso de la historia de la India, del sanskrito, del hinduismo, de la matemática y de la astronomía. Fue el primer líder popular del movimiento independentista indio.

Subhas Chandra Bose (1897-1945)  
Durante la II Guerra Mundial, propuso aprovechar de la crisis para lograr la independencia de la India, para lo que, controvertidamente, buscó la ayuda del Japón y la Alemania nazi, bajo cuyo auspicio se fundó el Gobierno Provisional de la India Libre en exilio con Bose como Jefe de Estado.

Mohandas Karamchand Gandhi (1869-1948)  
Pionero de la resistencia no-violenta por medio de desobediencia civil masiva, la cual ayudó a ganar la independencia de la India e inspiró movimientos por los derechos civiles en todo el mundo. En la India se le considera el "Padre de la Nación".

Muhammad Ali Jinnah (1876-1948)  
Abogado y político musulman. Inicialmente opuesto a una nación musulmana independiente, desde
1940 abogó por la creación de dos estados independientes en la India: India y Pakistán. Fue el primer Gobernador General de Pakistán.

Ver también: Mao Zedong, Ho Chi Minh, Che Guevara, M N Roy, Evelyn Trent

Lucha Armada y Guerrillerismo

A partir de los 1960s, estimando que bien existía una situación pre-revolucionaria en sus países o que los revolucionarios mismos la podrían crear con su ejemplo, diversos grupos y partidos concluyeron que la única vía factible para la revolución sería por las armas. En vista de los éxitos revolucionarios en Argelia, Cuba y Vietnam, se decidieron por la estrategia de guerra de guerrillas, tomando como guías principales a las teorías del foquismo de Che Guevara y de guerra popular prolongada de Mao Zedong. Por lo tanto, abandonan esquemas tradicionales y dan prioridad a la construcción de aparatos militares, elevando al guerrillero como máxima expresión del revolucionario y del comunista.

Ernesto "Che" Guevara (1928-1967)
Revolucionario internacionalista. Ayudó a crear y mantener el socialismo en Cuba, teorizó sobre nuevas formas de organizar la economía bajo el socialismo. Desarrolló la teoría y estrategia foquista y contribuyó directamente a luchas revolucionarias en África y Sudamérica.

Luis de la Puente Uceda (1926-1965)
Fundador, principal ideólogo y Comandante General del Movimiento de Izquierda Revolucionaria (MIR) peruano. Exponente de la teoría de focos guerrilleros como catalizadores de la revolución, Uceda y el MIR inician la lucha armada en 1965, la cual es prontamente derrotada por el ejército peruano, cayendo Uceda en combate.

Carlos Marighela (1911-1969)
Dirigente comunista y guerrillero brasileño. Electo a la Asamblea Constituyente de 1946 pero a fines de los 1960s sus críticas a la vía electoralista y urbana del PCB lo llevan a separarse y lanzar la guerrilla de Acción Libertadora Nacional.

Mario Roberto Santucho (1936 - 1976)
Destacado dirigente y organizador del Frente Revolucionario Indoamericano Popular y luego del Partido Revolucionario de los Trabajadores de Argentina y de su brazo militar, el Ejército Revolucionario del Pueblo.

Salvador Cayetano Carpio (1918 - 1983)
Político y dirigente sindical salvadoreño, conocido también por el seudónimo de Comandante Marcial. Fue fundador de las
Schafik Jorge Handal (1930-2006)
Secretario General del Partido Comunista de El Salvador y comandante guerrillero en el Frente Farabundo Martí Para La Liberación Nacional (FMLN) en los 1980s. Luego de los acuerdos de paz, dirigió al FMLN en su transición a partido electoral y fue electo diputado a la Asamblea Nacional.

Arturo Jarrín (1957 - 1986)
Fundador, principal ideólogo y dirigente del grupo armado insurgente ecuatoriano Alfaro Vive, ¡Carajo! (AVC!), el cual llevó acabo una lucha armada entre 1983 y 1991.

Ver también: Mao Zedong, Ho Chi Min, Camilo Torres, J. M. Beñaran, Archivo Histórico Revolucionario Salvadoreño

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Femenismo

Conjunto de teorías sociales y prácticas políticas que se desprenden de crítica a las relaciones sociales en base a la experiencia femenina. El feminismo explicitamente crítica a la desigualdad social, histórica y actual, entre mujeres y hombres y promueve la igualdad de derechos entre ellos. Las teorías feministas cuestionan las relaciones entre género, sexo, sexualidad y el poder social, político y económico.

Evelyn Reed (1905-1979)
Miembra del movimiento trotskista norteamericano, feminista socialista, y una de las primeras en cuestionar las justificaciones antropológicas y seudocientíficas del patriarcado.

Clara Campoamor (1888-1972)
Miembra del Partido Radical español, feminista republicana, y una de las primeras mujeres en ocupar un escaño parlamentario en su país, desde donde se puso al frente en la lucha por el sufragio femenino.

Flora Tristán (1803-1844)
Escriptora franco-peruana, fue una de las fundadoras del feminismo. Hizo campaña en Europa a favor de la emancipación de la mujer, en contra de la pena capital y por los derechos de los trabajadores.

Ver también: Alejandra Kollontai, Emma Goldman, Sección Temática sobre el Marxismo y la
A partir de los 1960s surgió en América Latina un movimiento dentro de la Iglesia Católica que puso enfasis en la figura de Cristo, no sólo como redentor, sino de libertador de la humanidad y en especial de los pobres y oprimidos. Esta tendencia, a la que se le ha denominado Teología de la Liberación, busca explorar la relación entre la teología cristiana y el accionar político por parte de los cristianos, instándolos a "optar por los pobres" y luchar por la justicia social. La Teología de la Liberación ha tenido repercusión internacional, jugando un notable papel en Nicaragua, El Salvador y Brasil, e influenciando a cristianos en países tan variados como los EEUU, España, Sudafrica, India, y las Filipinas.

Camilo Torres (1929-1966)
Sacerdote católico y sociólogo colombiano. Fue una de las figuras principales de un catolicismo contestatario internacional que se desarrolla en la década de 1960. Se vincula a la guerrilla del Ejército de Liberación Nacional y cae en combate.

Rutilio Grande (1928-1977)
Sacerdote jesuita y defensor de la teología de la liberación el El Salvador, donde ayudó a establecer Comunidades Eclesiales de Base y a ayudar en la organización del campesinado. Fue emboscado y asesinado por la reacción en 1977.

Anarquismo
Llameseles libertarios, acratas, o anarquistas, los exponentes del anarquismo han estado presentes en los movimientos obreros y socialistas desde sus inicios, defendiendo posiciones que varían desde el más extremo individualismo hasta el anarco-sindicalismo y el "comunismo no estatista." En el Siglo XIX los anarquistas fueron parte del naciente movimiento socialista, integrando incluso la I Internacional al lado de los marxistas. Esa relación no perdura y fue el deslindé de posiciones entre estos y aquellos contribuyó al fraccionamiento de la Internacional.
**Mikhail Bakunin** (1814 -1876)
Noble ruso quien promovió el anarquismo revolucionario. Participe de la I Internacional, de la cual llegó a liderar una importante fracción, en oposición a Marx y Engels, en los 1870s.

**Pedro Kropotkin** (1842 -1921)
Anarquista, escritor y geógrafo ruso. Se opuso a los Bolcheviques y vivió mayormente en el exilio, volviendo a Rusia poco antes de fallecer.

**Daniel Guérin** (1904 -1988)
Comunista libertario francés. Inicialmente militante trotskista, paulatinamente devino anarco-comunista. Fue además defensor de la homosexualidad y promotor del amor libre.

**Emma Goldman** (1869-1940)
Célebre anarquista de origen lituano conocida por sus escritos y sus manifiestos libertarios y feministas, fue una dura crítica del camino tomado por la URSS y una de las pioneras en la lucha por la emancipación de la mujer.

**Manuel González Prada** (1844-1918)
Poeta, pensador, ideólogo, periodista y reformador social anarquista peruano. Sostuvo duras polémicas en defensa de los indígenas, las mujeres, los obreros y la modernidad.

**Delfín Lévano** (1885 -1941)
Líder anarcosindicalista peruano, periodista, obrero panadero, además de poeta, clarinetista y conferencista. Fundador y redactor de los periódicos *La Protesta* y *El Proletariado*, y del grupo "Luchadores por la Verdad", entre otros. Tuvo destacado protagonismo en la lucha por la jornada de 8 horas.

Ver también: **Guy Aldred**, **Victor Serge**

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**Científicos**

**Charles Darwin** (1809-1882)
Científico inglés. Elaboró la teoría de la selección natural como motor para el origen de las especies. Fue muy admirado por Marx y Engels quienes vieron en sus ideas el reflejo de las propias aplicadas al mundo natural.

**Albert Einstein** (1879-1955)
Matemático y científico alemán. Elaboró la Teoría de la Relatividad y otros avances en nuestra comprensión del cosmos. Dedico el final de su vida a abogar por la paz y un gobierno mundial unitario.

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**Busqueda** | **Selección de Autores Marxistas** | **Archivos Temáticos**

Escoja el autor que desea leer:
| Temas específicos |  |
|-------------------|  |
| **Guerra de guerrillas** | **Marxismo y Literatura** |
| Aquí se reúnen textos que discuten la teoría, tácticas y métodos de la guerra de guerrillas, en ámbitos rurales tanto como urbanos, en base a las experiencias en diversos países. También se incluyen críticas al "guerrillerismo" y testimonios de experiencias guerrilleras. | Archivo en el que se reunirán escritos sobre la literatura, tanto como la producción literaria de autores marxistas, ya sea poesía, novelas u obras teatrales. Hasta el momento contiene secciones dedicadas a los poetas Javier Heraud, César Vallejo y Roque Dalton. |
| **Marxismo y Mujer** | **Materialismo histórico** |
| Archivo temático en el que se reúnen documentos relacionados a la experiencia femenina, cuestiones de género, el feminismo, y el marxismo, cuando posible desde un punto de vista femenino. | Esta bibliografía comentada sobre el materialismo histórico elaborada por Marta Harnecker y publicada en versiones variantes en las diferentes ediciones de su libro *Los conceptos elementales del materialismo histórico*, Los comentarios sobre las obras son extractos de los proporcionados por Harnecker. |
| **Primero de Mayo** | **Problema agrario** |
| Archivo en el que se reúne material y enlaces a páginas acerca del 1 de Mayo, el **Día del Trabajador**; sus orígenes, historia, y lo que tenían que decir acerca de él diversos autores. Además, información sobre eventos para el **1 de Mayo** en todo el globo. | Archivo temático en el que se reúnen enlaces y documentos relacionados a diversos aspectos de la problemática agraria: movimiento campesino, nacionalización de la tierra, reforma agraria, etc. |

**Experiencias de revolución en diversos países**

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<th><strong>China</strong></th>
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<td>Archivo en el que se reúne material sobre la Revolución China y el desarrollo del</td>
<td>Archivo sobre el proceso revolucionario en El Salvador. Se incluye material en</td>
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socialismo en ese país. Se incluye material diversos medios -escrito, gráfico, y video. en diversos medios -escrito, gráfico, y sonoro.

**India**

Archivo sobre el comunismo y el anti-imperialismo en el subcontinente indhistano.

**Nepal**

Archivo sobre comunismo, revolución, y lucha armada en Nepal, con enfasis en el Partido Comunista de Nepal (Maoísta).

**Palestina**

Artículos por pensadores y líderes palestinos y documentos relativos a la historia de palestina y de análisis de su situación.

**Unión Soviética**

Este archivo reúne materiales acerca de la historia de la Unión de Repúblicas Socialistas Soviéticas, principalmente escritos por testigos presenciales de los eventos y procesos que se describen.

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**Manifiesto del Partido Comunista**

Guía de estudio para el *Manifiesto del Partido Comunista* escrito por Marx y Engels en 1848.

**Materialismo Histórico: Bibliografía Comentada**

Esta Bibliografía refleja la bibliografía comentada elaborada por Marta Harnecker y publicada en versiones variantes en las diferentes ediciones de su libro Los conceptos elementales del materialismo histórico, el cual ha sido publicado en 62 ediciones desde 1969 por Siglo XXI Editores (ISBN: 968-23-1328-7), y ha atravesado además una edición en castellano por Editorial Vanguardia, Nicaragua, en 1987, dos ediciones en francés, una en inglés, dos en portugués, una en griego, y por lo menos dos ediciones piratas. La lista está ordenada según la fecha de ejecución de las obras. Los comentarios sobre los textos son extractos de los proporcionados por Harnecker en la 55ª edición (1988).

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**Indice de la Sección en Español**
Bienvenido a la Sección en Español del Marxists Internet Archive.

El Marxists Internet Archive (MIA), con sus diversos archivos en diferentes lenguas, sección de referencia, y archivos temáticos, nos provee la base de datos sobre el marxismo más completa y variada hasta la fecha. Estos archivos apuntan a ser la fuente y el centro de distribución de material marxista de hoy y van llenando el vacío dejado por la difunta editorial Progreso de Moscú la cual dejó abundante material, pero publicado con un criterio sectario. Nosotros hemos construido este archivo siguiendo la práctica simple y no-burocrática de voluntarismo y participación de base, lo cual creemos es clave para presentar información correcta y abierta.

El MIA consiste de voluntarios provenientes de todo el globo, desde Indonesia hasta Grecia, de Irán a los Estados Unidos, de Alemania al Perú. Las prácticas y afinidades políticas de los voluntarios del MIA son tan diversas como lo son nuestras nacionalidades, edades, e historias. Aunque contamos entre nuestro número a algunos escolares y universitarios así como a maestros, la mayoría no está vinculada a ninguna casa de estudios o centro intelectual. Todos estamos involucrados en actividades ajenas a la construcción de los archivos del MIA, desde participación política y nuestros trabajos diarios, hasta la crianza de nuestros hijos y la atención de nuestras familias y amistades. El MIA ha sido construido precisamente en esa manera, con el compromiso de gente común y corriente pero que, motivada por sus propias razones, le ha dedicado al proyecto unos minutos al finalizar la jornada o unas cuantas horas a la semana o al mes. Los materiales inclusos en los archivos han sido contribuidos a lo largo de más de una década por cientos de voluntarios, y la lista crece casi a diario.

Esta Sección en Español, desde sus inicios en noviembre de 1998, ha crecido muchísimo, pero aún queda mucho por hacer. Cuesta tiempo digitalizar y transcribir textos, por lo cual los avances pueden a veces ser rápidos, pero también a veces más lentos de lo que quisiéramos (vea nuestra página "¿Qué hay de nuevo?" para una lista detallada del crecimiento de esta sección).

Si está en busca de obras específicas que aún no se encuentran aquí, por favor busque en el archivo principal en inglés. Pero, por favor, tenga presente que la mejor manera de asegurar que algún texto específico aparezca aquí es contribuirlo.

Historia del MIA

En 1987 el primer archivo electrónico marxista fue creado por "Zodiac" en el ARPANET, el precursor al Internet. Este archivo, llamado el Marx/Engels Archive (MEA), tuvo como propósito publicar las obras de Karl Marx y Friedrich Engels en el ciberespacio, donde los costos y la censura no reinaban. La ciberética permitió la creación de una red de distribución de material marxista a todos los países del mundo, pero bajo el control y sujeto a las restricciones de ninguno. El primer texto marxista publicado en el ciberespacio fue, apropiadamente, el Manifiesto Comunista y de ahí se difundió ampliamente por redes electrónicas en todo el mundo.

En 1990 el ARPANET cesó y en 1991 Zodiac mudó el MEA a la red Gopher, uno de los primeros
elementos de lo que luego se llamaría el Internet. Dos años más tarde, en 1993, luego de la introducción del programa Mozilla por Netscape, Zodiac empezó a transcribir textos a formato html y nuevamente mudó el MEA, esta vez a la Red Mundial (WWW), es decir al Internet como hoy se le conoce. En ese año Zodiac y otros voluntarios transcribieron algunas de las obras principales de Marx y Engels, y comenzaron a transcribir a otros autores, empezando por _El Estado y la revolución_ de Vladimir Ilyich Lenin.

El primer servidor de WWW que hospedó al MEA fue csf.colorado.edu, por cortesía de Marta Gimenez y las agrupaciones _Communications for a Sustainable Future_ y Progressive Sociology Network. De ahí se difundió a medida de que en otros servidores en diversas universidades de EEUU, Canada, Sudafrica, Australia y Gran Bretaña se instalaron copias del archivo.

En poco tiempo, sin embargo, tanto el servidor en Colorado - EEUU como los espejos en otras universidades, se toparon con fallas técnicas o limitaciones impuestas por los reglamentos de sus instituciones, además de intentos por parte de políticos y decanos reaccionarios de excluir páginas izquierdistas del internet. A consecuencia, entre 1993 y 1995 varias instituciones clausuraron las copias del MEA hospedadas en sus sistemas. La página del MEA en Colorado cerró por dos semanas antes de que se le permitiera operar nuevamente, y unos cuantos otros sitios (CMU, Exeter y _Eserver_) continuaron operando por algún tiempo pero sin atención ni actualización alguna.

![](https://example.com/marx-engels-arch.png)

**Visite una copia parcial del MEA de septiembre 1996**

Estos problemas instaron a Zodiac a crear marx.org en un proveedor comercial de servicio de internet en octubre de 1996 y se cambió el nombre del archivo a _Marx/Engels Internet Archive (MEIA)_). El MEIA se expandió rápidamente a medida que la WWW entaba en más y más uso a nivel mundial. Mientras se continuaba el trabajo en la biblioteca Marx/Engels, algunos voluntarios instalaron y desarrollaron archivos para otros autores. En 1996 David Walters asumió la responsabilidad por el Trotsky Internet Archive, mientras que Mike Lapore se hizo cargo del Daniel DeLeon Internet Archive.

En 1997 diversos compromisos profesionales dejaron a Zodiac falto de tiempo para hacerse cargo de los crecientes deberes relacionados con la dirección de marx.org. Entonces, decidió nombrar a Sally Ryan como Directora de Comunicaciones del MEIA para responder a la correspondencia, comunicarse con los voluntarios, ayudarlos con transcripciones, montar nuevas páginas, etc., mientras que él permanecería como director general del MEIA.

A comienzos de 1998, Zodiac le informó a Ryan que había decidido que el MEIA debería volver a su propósito inicial y dedicarse en su totalidad a Marx y Engels. En mayo de 1998 Zodiac retomó control total de marx.org y cerró el acceso a la programación del MEIA. Sin embargo, Ryan continuó contestando la correspondencia y ayudando a los voluntarios a buscar nuevos hogares para los archivos...
que serían desalojados.

Luego del anuncio de la decisión tomada por Zodiac, David Walters, el director del Trotsky Internet Archive en MEIA, sugirió a los directores y voluntarios de los diversos archivos del MEIA la posibilidad de crear un nuevo archivo marxista que incorporaría los archivos desalojados del MEIA y más. La propuesta encontró acogida y se continuó la discusión al respecto.

En junio de 1998, Zodiac borró todos los archivos salvo los de Marx y Engels de marx.org. Poco menos de un año después, los azahares de la vida le impidieron a Zodiac proseguir con el proyecto y en marzo de 1999 marx.org dejó de existir.

En julio de 1998, fruto de las discusiones iniciadas por él, David Walters, junto con Jørn Andersen, Brian Baggins, Chris Croome, Luciano Dondero, John Gowland, Alphonsos Pangas, y Martin Schreder conformaron el Marxists Internet Archive (MIA).

Desde entonces el MIA ha crecido de manera impresionante. Sólo en 1999 se añadieron más de 15.000 páginas de texto a los archivos. De 1.800 por día en enero de 1999, el número de páginas html visitadas creció a más de 23.000 por día en enero del 2000. El número de usuarios creció en el mismo periodo de 9.000 al más a más de 32.000 por más. Como si eso fuera poco, ¡en febrero del 2000 el número de visitas fue de más de 1,2 millones y el número de usuarios subió a 57.000! Hoy en día, a más del servidor principal de marxists.org el MIA cuenta con "espejos" en Sheffield - Inglaterra, Canberra - Australia, Blacksburg y Dallas - EEUU, Moscú - Rusia, Galicia y Francia.

En noviembre de 1998, bajo la conducción de Jørn Andersen, se inicia la Sección No-Anglofona del MIA, la cual, a más de archivos en italiano, francés, griego, danés, y otros idiomas, incluye una Sección en Español. Hoy son veintiuno los idiomas en los cuales archivamos obras de escritores marxistas.

Aunque en relación a la sección principal en inglés, la Sección en Español es todavía pequeña, ha crecido enormemente en sus cinco años de existencia, y hoy incluye archivos de material en castellano de treinta autores marxistas, e incluye archivos de material de referencia, guías de lectura, archivos temáticos y los inicios de una enciclopedia. Gracias a gentiles colaboraciones de material por organizaciones e individuos en diversas partes del mundo la Sección en Español del Marxists Internet Archive hoy ofrece los archivos en internet mas grandes y completos de las obras de Marx y Engels, V. I. Lenin, León Trotsky y Mao Zedong en el idioma castellano. Recibimos cada vez mayores cantidades de correspondencia y contamos con contactos y voluntarios en Europa y multiple países de las Américas. A todos les damos las gracias.

En la actualidad el MIA consiste de un colectivo de individuos quienes dirigen diversas secciones del MIA, y una multitud de voluntarios. Cada director se responsabiliza por uno o más archivos o secciones, lo cual implica ayudar a digitalizar textos, coordinar los esfuerzos de los voluntarios, responder a la correspondencia, etc. A lo largo de los años los esfuerzos de muchas personas se han sumado para que este archivo pudiera ser una realidad. Las siguientes personas y agrupaciones han contribuido a lograr que el MIA sea lo que es hoy:

Gracias también a todas aquellas personas que nos han enviado, y nos envían, cartas de apoyo y aprecio, desde todas partes del mundo, de la Argentina hasta el Vietnam, de Nueva Zelanda a Rusia.
Si desea contribuir a la construcción de este archivo, o si tiene alguna interrogante o sugerencia, favor de ponerse en contacto con el Director de la Sección en Español. Si desea, puede utilizar el siguiente enlace para ello, o para contactar a cualquier otra sección del MIA:

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Filipinas: Para pedir un ejemplar del DVD si vives en las Filipinas, envía un correo electrónico a [mia.phils (-@-) gmail.com] e incluye tu dirección postal.

Sudáfrica: Para pedir un ejemplar del DVD si vives en Sudáfrica, envía un correo electrónico a [rasigann (-@-) gmail.com] e incluye tu dirección postal.

Sri Lanka: Para pedir un ejemplar del DVD si vives en Sri Lanka, envía un correo electrónico a [swithanage (-@-) marxists.org] e incluye tu dirección postal. En la línea de tema del mensaje escribe: "MIA DVD - SRI LANKA.

Turquía: Para pedir un ejemplar del DVD si vives en Turquía, envía un correo electrónico a [crimsonhawk77 (-@-) yahoo.com.tr] e incluye tu dirección postal. En la línea de tema del mensaje escribe: "MIA DVD - TURKEY".


Ex-Yugoslavia: Para pedir un ejemplar del DVD si vives en cualquiera de la repúblicas de la ex-Yugoslavia, envía un correo electrónico a [misu (-@-) yubc.ne] e incluye tu dirección postal. En la línea de tema del mensaje escribe: "MIA DVD - YUGOSLAVIA".

Hacerte distribuidor doméstico del DVD en tu país:

Estaremos contentos de explorar la posibilidad de agregar nuevos distribuidores locales en otros países. Para ser distribuidor de los DVDs del MIA en tu país, tendrás que estar dispuesto a cumplir los siguientes requisitos:

1. Debes poder hacer o mandar a hacer copias de DVDs.

2. Debes tener los recursos para solventar los gastos de producción -- compra de los discos en blanco, copiado, estuches, envío.

3. Debes poder entregar los DVDs en un plazo razonable para cada pedido.

4. Te debes comprometer a distribuir los DVDs a un precio que cubra tus costos pero sin lucro por encima de eso.

5. Debes residir un país que califique para recibir DVDs gratuitos.
Si tu o tu agrupación tienen interés en ser distribuidores locales en tu país favor de escribir a: payment [@] marxists . org.

¿Por qué vendemos los DVDs?: Si el MIA es clausurado por algún gobierno o conglomerado editorial, el tener toda esta información dispersa por el mundo, sin posibilidad de rastreo, sería una gran cosa. El poner todo este material en DVD le permite a cualquiera hacer copias y hacerlas circular. Hemos recibido mensajes de agradecimiento por parte de maestros en Indonesia y obreros en Inglaterra quienes regalan o prestan los DVDs a sus compañeros.

¿Por qué cuestan esa cantidad?: En parte por las razones arriba expuestas y también para recaudar fondos para cubrir los costos de funcionamiento del MIA. Una buena parte de nuestro presupuesto lo destinamos a cubrir el costo de enviar discos gratuitos a aquellos que no los pueden comprar en países en desarrollo.

Lee las siguientes instrucciones sobre como usar los DVDs en computadoras antiguas: No Windows ni MacIntosh.

¡Importante NOTA sobre el material NO incluido en los DVDs!

¿Preguntas acerca de los DVDs? Escribele al administrador encargado de los DVDs: D.Walters

Marxists Internet Archive

Libros de marxists.org

Disponibles por medio de Erythros Press

www.erythrospress.com
¿CÓMO CONTRIBUIR?

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- Guía de HTML

I. Transcribe texto

¿Cómo puedes ayudar? Hay diversas maneras, como verás a continuación, pero una de las mejores y más eficaces es con la transcripción de textos a formato digital. Para ellos necesitarás un "scanner" y un programa de "OCR" que interprete y convierta lo escaneado en texto editable, y el
texto mismo. También se puede transcribir documentos a mano con el teclado de la computadora pero demorará mucho más.

¿Qué puedes transcribir? Cualquier obra de cualquier autor para el cual tengamos un archivo. Si deseas transcribir un texto de un autor para el cual no tengamos un archivo, ponte en contacto con el director de la sección apropiada.

¿No sabes qué transcribir? Bueno, piensa en que te interesa. Por que al transcribir y revisar el texto uno lo lee, transcribir textos es una gran manera de colaborar y aprender algo a la vez. Haz tenido curiosidad por leer a Luxemburgo, a Gramsci, o a Mariátegui? Entonces digitaliza alguna de sus obras y aprende sobre ellos a la vez. O si no, indaga con el director del archivo que te interese y él te indicará lo que esta pendiente de hacer. Si el archivo no tiene autor ponte en contacto con el Director General del MIA.

¿No dispones de mucho tiempo? No te desesperes. Cada pagina de texto será muy apreciada. Si puedes digitalizar algunas imágenes, un capítulo de un libro, o un artículo breve, ayudará mucho. Gran parte del material en nuestros archivos ha sido reunido de esa manera.

Si alguien ya esta trabajando sobre un documento por el cual tenías interés, despreocupate, por que con mas manos a la obra el trabajo avanza más rápido, especialmente si se trata de documentos largos, como es un libro. El director del archivo se encargará de distribuir y coordinar el trabajo entre los diversos voluntarios que se ofrezcan.

Cuando acabes con la digitalización, revisa la ortografía ya sea visualmente o con la computadora. Si tienes tiempo, siempre es bueno leer el texto entero por si acaso hayan errores que el programa de revisión ortográfica no capte.

¡Ojo! Antes de empezar todo eso, es necesario que revises el documento que tienes a la mano para asegurarte de que esté libre de restricciones de propiedad intelectual (copyright). Si no estás seguro, pregúntanos y trataremos de averiguar algo al respecto.

Si deseas puedes agregar notas al pie de página o incluso una introducción o presentación de la obra. Considerate como un editor de ella. El director de la sección indicada se encargará de decidir que se publicará en el MIA. Si te parece que no ha sido justo, la materia se puede poner a disposición de la Junta Directiva del MIA para su discusión y arbitraje. Cualquier añadidura al texto contribuido será considerado de propiedad pública y distruisible bajo los términos de la Licencia GNU de Documentación Libre.

II. Agrega código HTML

Una vez digitalizado un texto requeiere que se le agere código para presentación en el internet. Actualmente el estandard que utilizamos es HTML versión 4.0, pero versión 3.2 es aceptable siempre y cuando se indique que eso es lo utilizado en la etiqueta DOCTYPE. También utilizamos Hojas Estilísticas en Cascada (Cascading Style Sheets, CSS), en versión 2, pero no es necesario que escribas una CSS, tan sólo que se incorporen los elementos en el código HTML que se agrege al documento.

Si recién empiezas a aprender a usar código HTML, o si quieres aprender, puedes empezar con agregar sólo las etiquetas más básicas de HTML al documento. Tenemos una Guía de HTML que te indicará cuales son estas etiquetas básicas y como usarlas. Por otro lado también esta la tarea de ajustar el código HTML de documentos digitales obtenidos de otros archivos al formato del MIA y a actualizar documentos viejos de acuerdo a la usanza de CSS.

III. Dirige un archivo
Diversos de los archivos aún no tienen quien los dirija. Si está interesado en dirigir uno de los archivos existente o uno que proponga crear, póngase en contacto con el director de la Sección en Español para archivos en ese idioma y con el Director General del MIA para archivos en otras secciones.

Para averiguar que archivos ya tienen directores, examine la lista de Directores del MIA. Cualquier archivo que no esté representado en esa página probablemente no tiene un director asignado. En algunos casos, propuestas para co-dirección serían bienvenidas. Para averiguar más sobre las responsabilidades de un director, lea el Director's Handbook.

IV. Imprime material para distribución

Hay muchísima gente, es decir, la mayor parte de la población mundial, quién no tiene acceso a computadoras y menos al internet, por lo que no pueden acceder a estos archivos en su formato digital. Con estas obras digitalizadas y distribuidas en forma gratuita, aquellos con computadoras las pueden imprimir y copiarlas para aquellos que no tienen acceso digital.

Establece tu propia imprenta. La manera más sencilla pero aún eficaz de hacerlo es imprimir una copia maestra con una impresora común para computadoras y luego hacerle copias fotostáticas. Esto se puede hacer con un mínimo de tiempo y dinero, los cuales pueden ser compartidos entre varios compañeros. De este modo pueden imprimir la información que les interese y la pueden distribuir o vender a librerías o en su sindicato, partido, organización, o en manifestaciones políticas.

V. Distribuye el DVD

Ayude a distribuir el DVD-ROM del MIA en su barrio o comunidad. El DVD ayuda a propagar la información contenida en el MIA a una audiencia más amplia y facilita su acceso por lectores con acceso limitado al internet y a aquellos sin él. Lo recaudado con la venta del CD se destina a pagar los costos de producción y distribución del DVD y los costos de mantenernos en internet. Si está interesado, póngase en contacto con el encargado del CD.

VI. Hospeda un espejo del MIA

Del lado más especializado de las cosas, nos encanta multiplicar nuestro archivo marxista en el ciberespacio. Si jamás nuestra biblioteca digital es atacada o sufre alguna catástrofe técnica, podremos dormir bien sabiendo que estas obras están ampliamente distribuidas alrededor del mundo. Echales un vistazo a nuestros espejos actuales.

Consideramos "espejos" a todas aquellas copias que se actualizan de manera regular. Aquellas que se actualizan por lo menos semanalmente son "espejos primarios"; aquellas que se actualizan con menor frecuencia pero por lo menos trimestralmente, son "espejos secundarios". Toda copia que no se actualize por lo menos cada tres meses lo consideramos un depósito digital.

Hospedar un espejo del MIA entero tomaría un poco más de 1 GB de espacio. Si prefiere hospedar un espejo de sólo un archivo o de una sección del MIA, sientete libre de hacerlo. Si quieres cambiar algo, hazlo; nuestras restricciones para el caso son las mismas que con todos nuestros documentos que caen bajo los términos de la Licencia GNU de Documentación Libre.

Si quieres instalar un espejo, con el programa rsync las actualizaciones se pueden hacer automáticamente. Si necesitas instrucciones sobre como usar rsync las tenemos disponibles. Si quieres instalar un espejo o depósito oficial (indicado en nuestra página inicial), póngase en contacto con nuestro conserje.
VII. Envíános libros viejos

¿Tienes un libro, periódico, o documento viejo? Si tienes algun texto que no este bajo restricciones de copyright, se lo puedes enviar al director del archivo indicado según el caso (ponte en contacto con él para obtener detalles de como hacerlo llegar) quien lo transcribirá o se lo pasará a algún voluntario para transcripción. En la mayoría de los casos no podremos devolverlos ya que, como otra materia prima, serán "consumidos" durante el proceso de producción. Si no deseas enviar el original, mandanos fotostáticas.

VIII. Señalanos los errores

Francamente, hacerlo no es muy emocionante que digamos, y a nadie le gusta oir lo que ha hecho mal, pero es sumamente importante que nos avises si encuentras algún error en el MIA. Si te topas con alguna página que no aparece, alguna omisión, enlace que no funciona, errores de código o textuales, etc., envíale una nota a la directora del archivo apropiado, indicando el error y la dirección de la página en donde está. Incluir el texto que rodea el error nos ayuda mucho en encontrarlo.

IX. Donaciones

Puedes ayudar al MIA con una pequeña donación. Somos una organización netamente voluntaria y sin fines de lucro. Todo dinero se destina a cubrir los gastos de mantenernos en línea y distribuir el disco compacto al rededor del mundo.

X. Propaganda

Cuando vayas a la biblioteca, coloca un papelito en algun libro sobre el marxismo apuntando al futuro lector hacia donde pueden encontrar obras marxistas gratis en internet. Coloca un aviso en la biblioteca, la librería, fábrica, oficina, local sindical, bar, o paradero de autobus, que propagandize el MIA. O usa los gráficos que aparecen abajo para propagandizar en tu página de internet o en las publicaciones de tu grupo o organización.

Hemos recibido informes de todo el mundo de parte de gente que obtuvo su introduccion al marxismo asi, encontrando un papelito en alguna copia del Manifiesto Comunista, viendo un letrero en el sindicato, etc. ¡Ayuda a pasar la voz sobre el MIA!

XI. Sugiere algo

¿Tienes ideas de como el MIA podría ser más llamativo o funcionar mejor? Envianos una nota.

Guía de HTML

Marxists Internet Archive