

Dialectical Materialism and Modern Science

I.—Everything has a History

By J. B. S. HALDANE, F.R.S.

IN the series of articles of which this is the first, I propose to examine the question of how far the scientific discoveries of the generation which has elapsed since Lenin wrote *Materialism and Empirio-criticism* have verified the principles of dialectical materialism. These principles were formulated by Marx, and in much greater detail by Engels, and developed by Lenin and Stalin. "Nature," wrote Engels¹, "is the test of dialectics," and dialectical materialism can only be accepted if it proves a guide not merely to an understanding of the development of science, but also to actual scientific research.

Its opponents say that it is a dogma to which scientific publications in the Soviet Union must conform, as scientific publications in mediaeval Europe had to conform to the current theology. But dialectical materialism does not state the nature of matter. "For the sole property of matter," wrote Lenin², "with the recognition of which materialism is vitally concerned, is the property of being objective reality, of existing outside of our cognition." It states that matter is in a constant state of flux, that development occurs through a struggle of opposites, and so on, but it does not lay down where in nature such struggles are to be found. It merely prompts us to look for them, and helps us to understand them when discovered.

A certain number of scientists today are idealists, partly because our knowledge of cerebral physiology does not yet permit of a detailed theory of mind, but largely because it is abundantly clear that matter does not have the properties which were ascribed to it a generation ago by the majority of scientists, though not, of course, by dialectical materialists. Hence the idealists conclude that matter does not exist. This conclusion is, of course, very welcome in reactionary circles. If matter is defined as consisting of indestructible atoms it certainly does not exist. But 33 years ago Lenin wrote "The recognition of immutable elements, of the immutable substance of things, is not materialism, but is metaphysical, anti-dialectical materialism." We shall see what has happened to the supposedly immutable atoms of nineteenth century science.

After Mendeleyev had formulated the periodic law, chemists gradually discovered new elements until today all but one of the 92 elements between and including hydrogen, the lightest, and uranium, the heaviest, are known, and one or two heavier than uranium are suspected. Aston found that these elements are mixtures of atoms of slightly different weights. In fact there are not 92, but several hundred kinds of stable (or more accurately nearly stable) atom, each atom consisting of a heavy nucleus round which

1. Anti-Dühring.

2. Materialism and Empirio-criticism.

from 1 to 92 much lighter electrons revolve. Rutherford showed that some naturally occurring atomic nuclei are unstable, and break down to yield lighter types of atom. But till recently these could be regarded as exceptions. In the last ten years, however, most of the elements have been bombarded with particles of high velocity, produced either by naturally radio-active substances or by the very intense electric fields, ranging to millions of volts, which modern developments of electrical industry have made possible. Such bombardments produce new types of unstable atomic nucleus. These are being discovered at such a rate that already probably more different kinds of unstable than of stable atom are known. The atoms of ordinary chemistry are only the survivors of a much greater number of less stable types, and even the stablest of them can be altered, and are constantly being altered, by cosmic radiation and other agents, though extremely slowly on our earth. But such processes must be relatively rapid in the interior of the sun and other stars, and act as the main source of their light and heat.

An atomic nucleus may be considered as built up of lighter particles, such as protons, neutrons, and electrons. These particles can be studied, and their properties determined, and physicists naturally tended to regard them as "immutable elements" once the atom had proved not to be immutable. But they soon proved not to be immutable either. For example there are electrons of positive as well as negative electric charge. They do not last long, for when a positive and negative electron collide, they pass over into a flash of high frequency radiation. And under certain circumstances radiation may generate a pair of electrons of opposite charges. "Contrary to metaphysics," wrote Stalin, "dialectic holds that nature is not a state of rest and immobility, stagnation and immutability, but a state of continuous movement and change of continuous renewal and development, where something is always arising and developing, and something always disintegrating and dying away." This view is completely borne out by modern physics, provided we realize that there is an immense range of different stabilities. The most transitory known objects, such as the particle called the meson, have an expectation of life of less than a millionth of a second. The stablest, such as the nuclei of ordinary atoms under terrestrial, though not solar, conditions, have an expectation of many thousand million years.

It may be answered that at least the laws of nature are stable, and that here at any rate immutability can be found. If so it is fairly clear that the universe is "running down," as Clausius believed, towards a condition of "heat death" in which the heat is evenly distributed, and that it cannot have existed forever in the past. Thus a creation, or at any rate some breach of natural law in the past, must be postulated; and we are back at essentially the Newtonian theology, where the creator established eternal laws and leaves the universe to work out its own destiny. This fits in very well with the ideology of a bourgeoisie which realizes that there was a pre-capitalist period, but believes that the laws of capitalist economics are eternal.

Engels did not completely escape from this difficulty. He saw that

3. History of the C.P.S.U. (B.)

thermodynamics, as formulated in his day, was self-contradictory, for the laws then given could not have held for ever. So he speculated concerning a building up of the lost heat of the stars into motion somewhere in the depths of space, which would allow the origin of new solar systems when our own has become cold. Thus eternity would be filled by cycles of more or less similar events, and the universe as a whole would have no history, being of the same general character as at present a million million years in the future or the past.

But some modern mathematical physicists, notably Lemaitre, Dirac, and Milne, take a different view, according to which laws of nature change, and the general character of the universe therefore alters, though, of course, very slowly. Milne's cosmology is the most fully developed of these, and the most dialectical. Our sun is one star out of perhaps a million million in a system whose densest parts we see as the Milky Way. We shall deal with the development of stars in a later article. Hundreds of thousands of other galaxies are known. The more distant they are the redder their light. This may be interpreted as due to their moving away, or to the speeding up of atomic events, so that light which started a hundred million years ago is of lower frequency, and therefore redder, than light which starts from similar atoms to-day. Each interpretation demands a different time scale and a different geometry. On the scattering or "expanding universe" interpretation light frequencies and rates of chemical change are constant. But everything, including material objects, is expanding by about one two-thousand millionth part per year; and two thousand million years ago all matter was packed into an indefinitely small volume, and ordinary physical events, such as the rotation of the earth, took place in an indefinitely short time. On the other interpretation there is no expansion, and no slowing down of physical events. However geometry is not Euclidean. The two interpretations are not different theories of the universe, but different systems of measurement. The latter is by far the more natural, as it takes ordinary standards such as the metre and the year, as constant, or very nearly so.

On this interpretation the past and the future are infinite, but in the remote past, say fifteen hundred million years ago, chemical processes were so slow relative to physical that life as we know it was impossible, and the sun and other stars probably produced less heat than to-day, while in the remote future chemical processes will be so relatively speeded up as to render life still possible even if there is a marked fall in temperature. Milne points out that this development, this qualitative change in the nature of things, is due to the contradictions between the time scale on which radiation proceeds evenly, and that on which the movement of masses is an even process. No doubt this is not a final account of the matter. Milne's theory accords with Einstein's special theory of relativity, but not with his later general theory, some features of which have been verified by observation. Probably later workers will be able to combine the useful features of both Milne's and Einstein's theories. It is of great interest to find that a natural philosopher who is probably almost uninfluenced by Marxism should ascribe the qualitative development of the universe to the struggle between the wave-like and particle-like characteristics which are present in all matter. To this unity of opposites we shall turn in the next article.

Food : What Could Be Done

BY GEORGE MATTHEWS

CAPITALISM has not only reduced agriculture in Britain to a state of chaos and decay: it has also instilled deep into the minds of the people the belief that the earth of their country is only capable of producing a miserable fraction of the food they need. Consequently, in the midst of the food shortage brought by imperialist war, the ruling class is able to get away with its soon out-dated slogans of "Bardia or Beef," its excuses of "lack of shipping space," and its continued criminal neglect of the resources of British agriculture. If the true facts about the potentialities of home production were brought before every man and woman who is to-day going short of eggs or milk or sugar there would be a tremendous uprising against the ruling class, which is neither willing nor able to do what could be done.

What are the facts? Half of the land is not being used as it should be (16½ million acres neglected), improving methods of cultivation are not applied, while instead of the doubling of production that was immediately possible all the much advertised war-time measures have brought about an increase in 1940 of one-and-a-half per cent.*

These facts can be demonstrated if we take a number of technical measures and calculate what increase in the production of a few of the more important commodities their application would bring. The most important of these technical measures are the ploughing-up of grassland and the reclamation of derelict land. Arable land will produce at least three or four times (and up to fifteen times) as much human food per acre as even the best grassland. Grassland ploughed up and re-sown to grass after proper fertilising, draining and liming, will produce three to four times as much cattle food per acre as old worn-out grass. There are millions of acres of extremely poor grassland in this country. In July,

* The authority for this 1½% is "The Dairy Farmer." Mr. Lloyd George, quoting secures sufficien for good health. Thanks to science and technical skill, we doubling of the produce of the land as generally accepted ("I have not met an expert who did not agree") and on the percentage increase challenged the Government to give the real figures, if his were inaccurate. No reply was forthcoming. The Government put up Tom Williams, Joint Parliamentary Secretary to the Ministry of Agriculture (with the Duke of Norfolk!) and the Labour Party's "expert" on agriculture, to reply to Lloyd George. Did he remember the words of a Labour Party pamphlet published in 1937, called "Labour Policy of Food for All (!)"? "The Labour Party believes that production and distribution of food ought to be so organised that every human being secures sufficient for good health. Thanks to science and technical skill, we can now produce all we require . . . Abundance is at our doors. Yet amid that abundance, alas, hundreds of thousands of poor children cry for the food that is being withheld from them or destroyed because their fathers and mothers cannot afford to buy." Alas, indeed, for the Labour leaders, who now perpetuate the situation they formerly condemned.