# Dialectical Materialism and Modern Science

## II. The Unity of Opposites

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

IN THE physical theories of the nineteenth century the constituents of the world were rather sharply divided into two groups. On the one hand were particles such as chemical atoms, on the other the field between them, or ether, which was the carrier of waves of radiation, including light, radiant heat, and radio waves. The term "matter" was often reserved for the particles, even after it had been found that radiation has mass.

In the twentieth century this distinction broke down. It was found that under certain circumstances radiation, including lights and X-rays, was not absorbed continuously, but in definite units, or quanta. The amount of energy in a quantum is quite independent of the intensity of the radiation, but proportional to its frequency. Thus light behaves both as if it were composed of waves, and also as if it were composed of particles, the particles containing more energy in blue than in red light, and far more still in X-rays. The analogy to matter became still stronger when light was found to have weight as well as mass. That is to say it does not merely push an object which absorbs or reflects it, but is bent out of its path by a heavy body, as the French revolutionary Marat had believed, on quite erroneous grounds. The deflection predicted by Einstein and found by Eddington was much smaller than what Marat believed he had discovered.

Still more startling was the discovery that ordinary matter and electrons have wave-like properties. These are already of practical importance in connection with the electron microscope. This is used for examining objects too small to be visible by ordinary or even ultra-violet light. For example it has shown that the grains in a developed photographic film have a complicated structure like that of a tangle of string. A beam of electrons is focussed by a combination of electric and magnetic fields which take the place of the lenses of an ordinary microscope. Such a beam behaves in many respects like a beam of light, provided the speeds of the electrons in it are uniform. It forms interference patterns with a suitable grating. And the wave-length of the electrons in the beam make it impossible to photograph objects smaller than this length, just as in the case of light. The frequency of vibration associated with an electron is constant, so the wave length is inversely as the speed of the beam of electrons. Atomic nuclei have similar wave-like properties.

The union, both in matter and light, of these wave-like and particle-like properties, allows the development of an extraordinary degree of complexity even in systems such as a single atom, built up of very few constituents Thus a hydrogen atom consists of two particles only, yet it can emit a spectrum in which many more light frequencies have been

measured than the number of notes in a grand piano. The branch of physics which deals with these properties is called quantum mechanics, and might well be called dialectical mechanics. For, at least as at present formulated, it ascribes both to ordinary matter and to radiation properties which common sense regards as irreconcilable. But this contradiction allows of extremely accurate calculation of properties of matter and light which can be measured.

So much for small pieces of matter. Let us pass to phenomena on a larger scale. Consider an organism which is not growing or diminishing rapidly, such as an adult man or insect, from the chemical point of view. Its intake and output of matter balance pretty exactly. But so do those of a steam engine or an internal combustion engine. The organism obeys the same laws as the engine as regards energy, but it differs in some fundamental respects, of which I only mention one. In the machine some parts last more or less unchanged through its "life"; others, such as washers, are occasionally replaced; whilst the lubricating oil is replaced still oftener, and the coal or petrol continually. In an adult animal it has long been known that the soft parts were constantly being renewed, proteins and other organic constituents being built up from the food, and then broken down and excreted. However one would expect that at least the hard parts, such as bone, would be stable like the hard parts of a machine. Hevesy fed adult rats with sodium phosphate containing some artificially made radioactive phosphorus atoms. He found that after a few days some of these were present in the solid material of the bones. Growth had ceased, but exchange had not. Thus the living substance is a unity of anabolism, or building up, and catabolism, or breaking down of chemical compounds, and this even applies to the bones. The end of this unity of opposites is death. Once an animal is dead, it is possible to preserve it, and the atoms in its tissues (may) mostly stay put for centuries.

If either tendency is carried too far, the unity is destroyed. A man may die of a disease like cancer, where too much material is built up in certain parts, or of a wasting disease such as diabetes, where not enough is built up. But all the manifold developments of life may be regarded as products of this struggle.

The struggle is very obvious within a community of plants and animals, or biocoenosis. All members of it, except plants (generally green) which live by photosynthesis, and saprophytic bacteria and the like, which live on dead organisms or excreta, live by killing or injuring other members. And yet these warring members form a unity which can be upset by altering the numbers of any of them. Thus if wolves eat deer which eat plants, there is a rough equilibrium, though numbers will fluctuate owing to good and bad seasons, epidemics, and so on. If the wolves are killed off the number of deer increases until it is limited by starvation. There are somewhat more deer, but mostly half-starved. Thus in practice some killing by beasts of prey is needed to keep the herbivora in health. Similarly cattle eat grass in a meadow. But they also eat and trample down larger plants which would choke the grass if it were not grazed. In fact an apparently hostile relation is often to some extent beneficial.

The experience of colonization has shown that the killing off of certain members of a community may easily upset the equilibrium by allowing another group of members to increase. There are violent fluctuations of numbers which generally at some point involve a destruction of green plants and impoverishment of the whole community like that which occurs in a capitalist trade slump. Within the unity of the group of species some pairs of species are on the whole antagonistic, some on the whole co-operative, but complete antagonism and complete co-operation are rare. There are obvious analogies with the State, but they must not be pushed too far, if only because the children of capitalists may become efficient workers, and workers may become capitalists, whereas many thousands of years would be needed before the lion would "eat straw like the ox." Still more important is the facts that man is characterized by production, so that human history is determined by economic as well as biological processes, and that he can to some extent consciously plan society, and thus ultimately escape from social forms which are determined by internal struggle.

Now let us rise still higher in the scale of magnitude, to stars. We know more than at the first sight would seem possible about the internal constitution of some stars at least, because the matter in them is not very densely packed, except perhaps at the centre; and though the temperature is very high, that is to say the atoms are moving very fast, their speeds seem to be no greater than we can obtain in a cyclotron. When atomic nuclei collide at these high speeds they sometimes unite, and heat is generated, as in ordinary chemical reactions, but in quantities which are about a million times as large per atom. The rate is sufficient to keep the sun shining at its present rate for many thousand million years. But the development of heat tends to make the stars expand, and the lessened density means fewer collisions, and therefore a slower heat generation. Similarly a decrease of temperature allows the star to contract under its own gravity, so that more collisions occur, and consequently more heat production.

In most stars these two tendencies are in equilibrium over short periods. But in one group of large stars, the Cepheid variables, they are not. These stars pulsate, expanding and contracting with periods of a week or so, and corresponding changes in light intensity. In case it be thought that I am dragging in "conflict" in the interests of Marxist theory, I may be permitted to quote from Gamow's popular "The Birth and Death of the Sun": "The pulsations come as the result of a conflict between the nuclear and gravitational energy-producing forces in the stellar interior." And in the long run the equilibrium is not stable, in many cases at any rate. Stars undergo two types of explosion. One type produces an ordinary *nova*, a so-called new star of which one flashes up in our galaxy every few years. This is not really a new star, but a vast increase in the light of a previously faint one. The other type, or *super-nova*, is far more brilliant. An explosion of this type occurs in our galaxy about once in a thousand years, and the exploding star is visible in broad daylight. Enough *super-novæ* have been seen in other galaxies to make it fairly clear that the explosion

is much more intense than the ordinary *nova* explosion.

It seems probable that most, if not all stars, explode in one of these ways once in their lives, and then change their structure considerably. It also seems that the explosions are not due to collisions or any other external agency, but to the internal struggle between the expansive and contracting tendencies, which, after millions of years of apparent equilibrium, produces a qualitative leap.

Many more cases might be given, notably the modern chemical theories of tautomerism and resonance energy, especially as developed by Pauling. But these examples should be sufficient to show that recent work is tending to verify Lenin's statement as to "the contradictory, mutually exclusive, opposite tendencies in all phenomena and processes of nature," and the view that the struggle between these tendencies is the cause of development.

# ON TO FIVE HUNDRED !

Fifty-one new Discussion Groups have been reported to us this month. There are now over two hundred and fifty Groups actually known to us. The tempo of growth is sharply increasing. Within a measurable period there will undoubtedly be FIVE HUNDRED of these Groups in active existence. If your district, street, housing block or workshop has no Group yet, get it formed in July—our Birthday Month—and have it numbered amongst the foundation five-hundred Discussion Groups.

*Space now forbids our giving a full list of Groups each month—a full list was given in our June issue. The following places are where Groups have been formed during the last two months only.*

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| Aberdeen | Coulsdon | Kensington (Nth) | Ruislip |
| Aberporth | Dartford | Kidderminster | Saltcoats |
| Andover | Dorset | Lambeth | Sedgley |
| Ashby-De-La-Zouch | Dulwich | Lancaster | Slough |
| Bacup | Dunstable | Leicester | Southall |
| Barking | Eastcote | Leyland | St. Annes-on-Sea |
| Beaconsfield | Edinburgh | Llanelly | St. John's Wood |
| Bedford | Epsom | Lowesmoor | St. Helen's, Lancs. |
| Bermondsey | Fareham | Maidstone | Stoke-on-Trent |
| Bideford | Gloucester | Maldon | Stockport |
| Bilston | Hampstead | Malvern | Stratford-on-Avon |
| Birkenhead | Hanwell | Manchester 18 | Southampton |
| Blackpool | Hanworth & Feltham | Marple | Sutton Coldfield |
| Bletchley | Hayes (Midx) | Mitcham | Tulse Hill |
| Brentwood | Hemel Hempstead | Nantwich | Walsall |
| Brighton | Hertford | Newark | Watford |
| Brynmawr | Heston | Newcastle (Staffs.) | Welling (Kent) |
| Bush Hill Park | Hillingdon | Newdigate | Winchester |
| Burry Point | Hitchin | Northolt | Windsor & Eton |
| Chester | Horsham | North Harrow and Raynes Lane | Wolverhampton |
| Chingford | Ilford | Plumstead | Woodford Bridge |
| Cleethorpes | Iver | Ringwood | Worksop |
| Clifton | | | Yeovil |

Groups are in process of formation in the following towns. Will all readers in these districts communicate with us:

Chesham Dunbarton Malvern Paddington Watton (Norfolk)

Special Discussion Notes on each issue of the LABOUR MONTHLY are prepared by the Groups Department and sent to every Convenor. These form an invaluable basis for the study of each issue. These are also valuable to individual readers at the price of 3s. 0d. per annum.

Please address any enquiries to Discussion Groups Department, 134, Ballards Lane, N.3. We shall be delighted to help you.

# The Labour Conference

## (under Tory patronage)

BY E. M. WINTERTON

IN 1936 and 1937 the Labour Party leaders refused to join in a common front with the Communist Party, the Liberal Party and the Co-operative movement in order to defend the democratic Republic of Spain, and thereby make possible an international peace bloc with the U.S.S.R. which would have prevented the war. Since 1940 the Labour Party has been in a coalition with the Liberal Party and the Tory Party to defend the British Empire, in a war brought about by the absence of the peace bloc. Refusal of coalition in the interests of the working people when that would have upset the plans of British Imperialism, acceptance of coalition with the capitalist Parties when that is required by the dire necessity of British Imperialism: no wonder the Labour Party Executive took every step possible to throttle discussion before and at the Labour Party Conference this year on this crying contradiction.

The gagging of the rank and file, as expressed by the refusal to allow them to send in considered resolutions from local organisations, was all the more necessary because the policy of coalition had very little but disaster to report, so far as concerns the common people. When the Conference opened in London on June 2, the country was full of doubt and criticism of the Government over the defeat in Crete. The waste, inefficiency and robbery in connection with war production was a constant topic of public and private discussion. The revolt of housewives and many other great sections of the people against the scandalous class privileges permitted in the food supply was spreading. In the great towns, problems of fire-watching and of proper air-raid protection for the civil population were more urgent than ever. In India many thousands of the champions of national liberty against British oppression were suffering internment, ill-treatment and privation of elementary political rights. The government of which Messrs. Attlee, Greenwood, Dalton, Morrison and Bevin are leading members was inflexibly pursuing the same policy as Chamberlain towards the U.S.S.R. Attempting to profit by all this to promote a fascist Anglo-German peace, at the expense of the common people of both countries, Hess had landed in this country amid a sympathetic demonstration by the entire millionaire-owned British press (including the *Daily Herald*), and by such figures as Sir Nevile Henderson, former British Ambassador in Berlin, and Mr. Ward Price of the *Daily Mail*.

The Labour Party Executive was very careful to prevent discussion which would have revealed the subservient part it had played on all these fundamental issues. This it ensured by the procedure already mentioned —of allowing no local resolutions, and of submitting merely its own report for acceptance or amendment page by page. Yet, lest this procedure