Modern Aristotelianism

By Dr. Herbert Dingle

And we do hereby make and constitute the said Society by the Name, President, Council, and Fellows of the Royal Society of London, to be a Body corporate, to be continued under the same Name in a perpetual Succession; and that they and their Successors (whose Studies are to be employed for the promoting of the Knowledge of natural Things and useful Arts by Experiments . . .) shall . . . (First Charter of the Royal Society, 1662.)

It is, in fact, possible to *derive* the laws of dynamics rationally . . . without recourse to experience. (Prof. E. A. Milne, *Proceedings of the Royal Society*, A, 158, 329; 1937.)

IT is not easy to express in a phrase the idea which early in the seventeenth century became the 'experimental philosophy' now called science, but we shall not err seriously if we adopt the statement that the first step in the study of Nature should be sense observation, no general principles being admitted which are not derived by induction therefrom. The 'Aristotelianism' with which this idea waged what is usually regarded as a successful and final battle was, by contrast, the doctrine that Nature is the visible working-out of general principles known to the human mind apart from sense perception.

Both sides thought of Nature as existing externally and objectively. It would conform better with modern physics to speak of science in more subjective terms as the formulation of rational relations between sense observations. This definition has the advantage of providing an automatic safeguard against the Aristotelian fallacy: Nature conceived objectively may have parts inaccessible to observation about which we are tempted to dogmatize; but if our aim is simply to rationalize observations, such inaccessibles cannot distract us.

Nevertheless, the issue between Galileans and Aristotelians is still sharply defined. In the new language, the controversy was concerned not so much with the proper way of doing a thing as with the thing which it was proper to do: Should we deduce particular conclusions from *a priori* general principles or derive general principles from observations? Intellectual activity involves two elements—call them either Nature and the human mind, or experience and reason. To the Aristotelian the human mind had super-sensory knowledge of the principles which Nature obeyed, or alternatively reason could, apart from sense, dictate the course of experience; to Galileo, Nature was independent, and the mind could watch and try to describe in general terms her processes, or

alternatively reason could seek to correlate sense observations into a logical system. To the Aristotelian, man was, in a sense, the measure of all things. To Galileo, "Nature nothing careth whether her abstruse reasons and methods of operating be, or be not, exposed to the Capacity of Men".

History shows few examples of loyalty to a trust comparable with that of the succeeding generations of scientific workers. It is no idle boast that until now the thoughts and practices of men of science have been such as Galileo would have approved. Even merely verbal heresies, such as the statement that science is based on faith in an 'Order of Nature' have been few and harmless; we may have said such things, but we have always acted as though Nature might nothing care for what our minds call order. It is not a light matter, then, when we find in our own day a revival of Aristotelianism in the front ranks of science itself.

The phenomenon may be described in broad terms as an idolatry of which 'The Universe' is the god. Precisely what 'The Universe' means is not always easy to discover; its worship is sometimes mono- and sometimes poly-theistic, and no two votaries appear to bow before the same altar. But its various forms have this in common, that they transcend observation and cannot be derived by induction from observation alone. Furthermore, having been created, they dominate experience instead of representing it.

This cosmolatry, as might be expected, came by metaphysics out of mathematics. What is more surprising is that the world of science generally is accepting it with at best a silent protest, kept inarticulate by a lurking fear that what cannot be understood might haply be true. Thus we find among the general public a vague belief that physics is simply the study of the universe, and in the scientific world itself the wholesale publication of spineless rhetoric the irrationality of which is obscured by a smoke-screen of mathematical symbols. It is worth while to see how this has become possible.

The theory of relativity appears to be the innocent cause. It is no secret that when that theory burst upon the world it was very little understood. The new mathematical knowledge and the uprooting of deep-seated prejudices which understanding demanded were thought exorbitant, and the price was not paid. But the theory could

not be ignored. It solved a long-standing astronomical problem and successfully predicted a new phenomenon, and these were the hall-marks of true science. Hence relativity had to be accepted. Now it happened that early in its career it was speculatively applied to the universe, and the most widely read introductions to the theory included descriptions of this application. Consequently the bewildered physical world came to imagine a necessary association between relativity and cosmology and, believing where it could not prove, extended to the cosmical speculations the scientific sanction which had been earned only by the underlying system of mechanics.

This was a mistake. The relation of relativity to the universe is in principle precisely the same as that of Newtonian mechanics: both concern the behaviour of any mechanical system whatever, and can therefore tell us nothing about the peculiar character of any particular system. Newtonian mechanics could not state the number of planets in the solar system or the distribution of masses in the universe, but if these things were found by observation, it could tell how the bodies would interact. Relativity mechanics has exactly the same limitation and the same power—a fact which, so completely has the situation been misunderstood, will probably be news to many physicists. How, then, is it applied to the universe? Simply by making assumptions, which by now have become dogmas. It is assumed that the universe is homogeneous. Why? Because the possible alternatives, being infinitely numerous, must be ignored if we are to make our speculations definite. It is assumed that the universe is isotropic for the same reason. It is assumed that the characteristics of the possibly infinitesimal region we have observed are not merely local but also are copied by all that we have not observed. Why? Because that assumption brings the universe within the scope of our mathematical attainments. In this way we reach our grand modern conception of 'The Universe', on which we proceed to build laws of Nature far superior to those paltry inductions from phenomena that Newton ranted about. Our new laws are universal, eternal, established on the rock of divine mathematics, and in the tumult of their coronation no one hears a still, small voice which says, "Nature nothing careth whether her abstruse reasons and methods of operating be, or be not, exposed to the Capacity of Men."

The new Aristotelianism has now grown so confident that we have no need to unmask it: it has itself discarded masks, and we have only to recognize it for what it is. Sir Arthur Eddington, for whom the "cosmical constant", which Prof. A. Einstein thinks illusory, is a "fundamental con-

stant of nature", tells us that "there is nothing in the whole system of laws of physics that cannot be deduced unambiguously from epistemological considerations. An intelligence, unacquainted with our universe, but acquainted with the system of thought by which the human mind interprets to itself the content of its sensory experience, should be able to attain all the knowledge of physics that we have attained by experiment". But Eddington's own practice refutes his creed. He is too great to be the slave of chimæras, and his generalizations are but unsuccessful attempts to utter what he finds inexpressible. If he had a philosophy big enough for his intuitions we should know something.

Prof. E. A. Milne's "kinematical relativity" has quite a different character. Here we not only establish mechanics on 'The Universe' instead of on Newton's "manifest phenomena", but also we invent our own universe so as to be seraphically free from the least taint of observability. This creation is defined by the "Cosmological Principle", which selects out of all conceivable bodies those which, if they had observers on them, would restrict the behaviour of such observers to a certain mutual conformability. Verbal respect is paid to old-fashioned prejudices by the admission that there *is* an actual universe of which this is only a selected part, and, etiquette having thus been observed, hundreds of pages and thousands of pounds are being spent on calculation of the properties of this "selection" by a growing army of "research" workers. In this campaign observations can be what they will provided the functions keep their ancient places; a question is "answered" when the equation is formulated. Thus the question how long the system of nebulae has existed is "resolved" by saying that it may be for years or it may be for ever, "according to circumstances". The further question, how the possible "circumstances" are related to experience, is not worthy even to be asked. "Whether the actual universe follows the details of the extrapolation is quite immaterial," says Milne. In other words, we admit that Galileo had a programme, but we, for our part, will be Aristotelians.

Perhaps this comparison is unfair, for no one can deny to the Aristotelians the gift of logical acumen. To their modern representatives it seems as though a fancy is no sooner in the head than it is on paper and sent for publication regardless of logical consistency. Thus, in the first paragraph of a recent paper, Milne, after asserting that "all the matter in the universe . . . must necessarily be taken into account in describing the motion even of a free particle", immediately announces that he fulfils this requirement by restricting his considerations to matter which obeys the

cosmological principle. Again, he claims to deduce the Doppler effect from the manner in which the cosmological principle leads two or more observers to reconcile their clock readings, and hails this as evidence that the actual universe obeys the principle (indeed, Milne believes that God could not have made the universe otherwise). But obviously the Doppler effect could be detected if only one observer existed, so its derivation from the sociability of many must be fallacious. And so on.

This combination of paralysis of the reason with intoxication of the fancy is shown, if possible, even more strongly in Prof. P. A. M. Dirac's letter in *NATURE* of February 20 last, in which he, too, appears as a victim of the great 'Universe' mania. In essence the argument is this. Large numbers need an entirely different type of explanation from small ones (since the number of pure numbers is infinite the distinction is meaningless, but meaning seems to be irrelevant to these considerations). If, from an indefinitely wide choice, we select a certain unit of time ("say the unit e^2/mc^3 "), the age of the universe according to one cosmological speculation is "about" equal to the square root of the number of protons in the universe according to another, and to the ratio of certain electronic forces. Hence we may take it as a "general principle" that *all* large numbers, etc. "In this way," adds Dirac, "we avoid the need of a theory."

The position must not be misunderstood. We are not dealing here with legitimate imagination transcending the temporary limits of exact demonstration. Nothing is easier and nothing is more deadly than to call for the stifling of all ideas that cannot here and now be proved of

permanent value. But the question presented to us now is whether the *foundation* of science shall be observation or invention. Newton did not lack imagination, but he chose to examine pebbles rather than follow the Gadarene swine, even when the ocean before him was truth. Milne and Dirac, on the other hand, plunge headlong into an ocean of "principles" of their own making, and either ignore the pebbles or regard them as encumbrances. Instead of the induction of principles from phenomena we are given a pseudo-science of invertebrate cosmythology, and invited to commit suicide to avoid the need of dying. If anyone is uncertain about the place of imagination in science, let him compare Lord Rayleigh's discovery of argon with Dirac's discovery of the contemporary creation of protons which, according to *The Times*, "alters fundamentally our ideas of the structure of the universe and the nature of time".

Nor are we dealing with a mere skin disease which time itself will heal. Such ailments are familiar enough; every age has its delusions and every cause its traitors. But the danger here is radical. Our leaders themselves are bemused, so that treachery can pass unnoticed and even think itself fidelity. It is the noblest minds that are overthrown, the expectancy and rose of the State which was lately so fair and in which there is now something so rotten that the very council of the elect can violate its charter and think it is doing science service. Five years hence we shall be celebrating the tercentenary of the death of Galileo and the birth of Newton. It rests with us whether we shall present to their memories a living monument of their own foundation or the resurrection hymn of their adversaries.

Rural England at the Royal Academy

MANY of the subjects which enlisted the enthusiasm of British artists fifty years ago, notably the historical and military, have faded out of modern exhibitions, but the scenery of the English countryside and coast retains its attraction, and is fully represented in this year's Academy. Landscape, and especially English landscape, is the principal subject of the water-colour paintings. These, relegated to a side gallery, are generally viewed after the eye has become attuned to the larger and stronger oil paintings.

It may be well, therefore, for those interested in landscape to visit the South Rooms first. Here

are studies of the coast of Cornwall, the Cotswolds, the Sussex Downs, the Fens and Yorkshire moors, and examples of historic architecture such as the castles of Richmond, Bamburgh and Holy Island. The country church as the principal feature in East Anglian landscape is well treated in "Morston, Norfolk" (889) by Mr. Harry Morley. The seasonal aspect of the country landscape is beautifully rendered in Mr. E. W. Haslehurst's "Winter" (764), where yellow reed beds are reflected in still water and backed by a dark thicket of bare boughs. "March Landscape" (949), by Mr. Victor W. Burnand, is a careful rendering of the tracery of elm boughs seen against the evening sky.