Science and Philosophy.

By Prof. H. WILDON CARR.

I.

THERE are men of science who are undisguisedly alarmed and greatly discouraged at the tendency of the new mathematical and physical theories to plunge science into metaphysics. The new principles seem to be throwing doubt on the basis of science and confusing the pure positivity of its method. The value of the scientific work of the mathematicians who have formulated the principle of relativity is unquestionable and unquestioned, but their abandonment of the common-sense basis of scientific reality seems to many a high price to pay for an advance in theoretical knowledge. The fear goes deeper. Twenty-five centuries of philosophical speculation have failed to produce any general agreement among philosophers on the fundamental principles of metaphysics. If physical science is to be dragged in as arbiter to decide problems of epistemology, can its own principles be kept free from the doubt and obscurity which invade metaphysics? The authors of this trouble are not speculative philosophers, insinuating dialectical paradoxes, upsetting scientific workers in their straightforward experimental researches, but men of science with a particular genius for pushing scientific investigation into domains which, in the literal meaning of the term metaphysics, lie beyond physics.

On two points in particular the principle of relativity is disquieting many students engaged in research who are still convinced of the soundness of the assumptions on which science has hitherto been based. First, it insists on taking into consideration the conditions of knowledge, and in so doing it seems to be undermining the basis of physical science by challenging the absolute criterion of truth and introducing a scepticism of the instrument. If, before we can affirm a scientific fact or law on the evidence of simple observation, we must inquire what knowing and its conditions are, then it seems that we abandon for good and all the positivity of science as truth about reality, for the authority of reason depends on its absolute disinterestedness. Secondly, the principle of relativity presents the physical universe as mediately constructed from individual experience and not as immediately revealed to it. If the universe is constituted of systems of reference, and if each system though in relative movement is at rest for the observer attached to it, and if this is a condition of the observation of natural phenomena, then it seems that the positivity of science is made impossible by the very nature of physical reality, that the leaven of subjectivity has corrupted the whole conception of a pure object of physics, and there is introduced a scepticism of the foundation of science.

When each of these consequences of the new principle is examined in its full significance, however, not only is all ground of alarm removed, but also a far surer positivity of science is discovered. The fact is that until the twentieth century, and the coming of the principle of relativity, physical science never has built on impregnable rock, but always on improvised foundations.

I propose in the present article to examine only the second of these two points, that, namely, which concerns the mathematical principle of relativity and what is frequently described as its idealist interpretation. In a second article I will deal with the still more fundamental point, the problem how the intellect, which is a product of biological evolution, can yet furnish a criterion of scientific truth.

It is not the principle of relativity itself, as Lorentz and Einstein employ it in determining the subject-matter of physics, but a corollary of that principle, which seems to infect the basis of physical observation with scepticism. It is the implication that the conception of a common universe, independent of particular viewpoints of observation, a conception which is held to be an indispensable presupposition of science, is not imposed on the observer from without but constructed by him from within. According to the principle of relativity the physical universe consists of mass systems in movement, and the movements of these systems are not absolute but relative to one another. Consequently, it is a condition of observation that any observer attached to any one of these relatively moving systems, if he would measure and co-ordinate the phenomena of the universe, must *experience* his own system as a system at rest, as a system the movement of which is always zero. From this it clearly follows that observers attached to different systems have different experience and actually co-ordinate the universe from different viewpoints. It would seem, therefore, that there can be no possibility of agreement between them in the meaning of a common objective reference, such as has hitherto always been attributed to physical science. This seems to introduce subjectivity into science in a peculiarly insidious form, to turn reality into appearance, to reduce objectivity to illusion. The new science, in departing from the simplicity of the old, seems of necessity to be sacrificing the objective reference which constitutes its positivity.

There are two alternative ways, and only two, of interpreting the fact that individual subjects of experience think there is a common universe independent of their perceptions and ideas, to which their perceptions and ideas refer. One way is to assume that a physical world does exist in its own right and that in some way by its influence on receptive minds it reveals itself in the form of representations or ideas. This is the ordinary assumption of common sense, and hitherto it has been the accepted presupposition of physical science. The other way is to account for the idea by the internal activity of individuals and what is common in their experience, and to interpret the concept of the physical universe as a function of modes of experience and as a product of trans-subjective intercourse. This theory has been put forward in various forms by philosophers dissatisfied with the common-sense view. The difficulty of the first view is that the relation of knowing to being is utterly incomprehensible and invites the challenge of scepticism. The difficulty of the second is that it can find no means

of assuring that the physical world is not wholly, what it must be partly, an illusion. These are the alternatives, and the principle of relativity, moved by a purely scientific necessity, not by a logical consideration, or by a speculation of philosophy, has decisively rejected the first and adopted the second. When the reason for this choice is understood, physical science may seem to have had to sacrifice its primitive simplicity, but it will be found to have established itself on a much firmer foundation.

For some centuries of human history no one has been able to doubt that the earth moves, rotating diurnally on its axis, translated annually in an orbit round the sun. Yet though it never occurs to any one to doubt this, no one from the time of Copernicus onwards has been able to change the belief that the earth moves from an intellectual induction into an actual immediate sense experience. No one feels the earth move. We may safely affirm that no one ever will. But the reason is not easy to understand. In fact, the case is unique. In all ordinary terrestrial experience it is to feeling we appeal. We may be ignorant, or at least imagine ourselves ignorant, whether it is the train we are in or the landscape outside which is moving, but when we have decided we can always acquire the direct positive feeling of translation. In the case of the earth we cannot. It is not difficult to suggest reasons to account for the inability. It may be a product of evolution with a definite survival value. There is, however, a closely related fact, which recent scientific experiments have demonstrated, and which we cannot account for in this or any similar way. We now know that not only can we not feel the earth's movement, but also we cannot discover or demonstrate it by any of the effects we should expect it to have on our observations of physical phenomena. It has none of these effects—so far as they are concerned the earth is at rest. It is true that we can see an effect of the earth's rotation in the tracing of the movement of Foucault's pendulum, just as we can see the effects of the earth's translation in Tycho Brahe's mappings of the planetary courses, but we cannot discover the earth's movement by taking it into account as a factor in our measurements of velocities.

This is a positive discovery, and it is a scientific necessity that we should know why. It was to meet this very case that the principle of relativity was formulated. It is the absolute condition of the possibility of a scientific co-ordination that we should

experience the system to which we are attached and by reference to which our measurements are made as at rest. In fact, were we earth-dwellers able to feel the earth moving or become aware of its movement in the effect on our observations, then no measuring-rod we could devise would measure space and no clock would mark uniform time. It is, therefore, a condition of physical science that the earth-dweller be insensible to the earth's movement.

No one is likely to dispute that it is a need of scientific interpretation of experimentally demonstrated fact which has led to the principle of relativity. What distresses many men of science is the loss of simplicity. The Newtonian scheme had formidable difficulties, but they were purely metaphysical, and science has prided itself on an easy way with metaphysics. This has been to follow the method which Auguste Comte taught, to recognise the phenomenal character of scientific reality, proclaim the arrival of the positive stage, and relegate metaphysics to the unknowable. Modern science has declined to humble itself and confine itself within self-imposed limitations, and it is enjoying its reward. Comte told us we could never know what the stars are made of, and we never should have known had science been content with his method. The science of the twentieth century is on a far surer basis, just because it has not foolishly thought to secure itself by fencing itself in and excluding metaphysics. The new principle calls on us no longer to accept physical reality as a direct revelation, but to construct our conception of it by metaphysical inquiries based on the conditions of observation.

The principle of relativity has given new meaning to the aphorism with which Bacon begins his "*Novum Organum*." "Man, as the minister and interpreter of Nature, does and understands as much as his observations on the order of Nature, either with regard to things or the mind, permit him, and neither knows nor is capable of more." Science has its limitations and its boundaries, but these are neither imposed from without nor surveyed from an independent vantage-ground. They are determined from within. The old conception was too simple. If for our scientific generation physics is dependent on a difficult mathematical work of intellectual construction, and if the relativity implied in this constructive reality can never be overcome, it is this very relativity which delivers science from scepticism by enabling truth to be absolute.

(To be continued.)

Obituary.

SIR WILLIAM MACEWEN, F.R.S.

SIR WILLIAM MACEWEN, professor of surgery in the University of Glasgow, died after a short illness on March 22, in his seventy-sixth year. He was born at Rothesay in the Isle of Bute, June 2, 1848, the youngest son of a large family which had to be reared and educated on the limited income which fell to his father, a mariner-trader. He became a student of medicine in the University and Royal Infirmary of Glasgow in 1865, this being the year in which Lister applied for the first time an antiseptic dressing in the old Infirmary. He graduated in medicine in 1869, just as Lister was moving from Glasgow to succeed Syme in the chair of

clinical surgery in Edinburgh. He remained in Glasgow to become house-surgeon to Lister's lieutenant and disciple—George Macleod.

Macewen was thus reared in the cradle of Listerism, and from his student days realised to the full that a new era had dawned upon surgery. As he grew into manhood he developed the attributes one would like to ascribe to an ideal Highland chief—a tall, erect, well-proportioned figure, a long and finely balanced head, clean-cut but ample features of face, and a thrustful, vigorous, masterful attitude of mind. He did not shine in examinations, for he was one of those who must see and handle facts before they can be absorbed and