

Metaphysics of the Physical World

RECENT letters to NATURE commenting upon Prof. Dingle's analysis of the Georgian era in physics express different views on the ultimate status of the physical world. The following discussion offers a foundation upon which all philosophers of science can agree. Philosophical differences arise if one seeks a deeper interpretation of the fundamental principles.

Prof. Dingle has shown that the new physics has been guided by a principle of observability: only those concepts that can be exemplified in observation are to be admitted in physical theory. The philosophical theory of logical positivism also employs the foregoing principle in the form of an empiricist criterion of meaning. The basic theory of the present discussion will conform to this principle.

The physical world consists of tables, chairs and other perceptible things. A thing is something of which aspects are given in perception. An aspect is an immediate datum of experience, for example, the visual aspect of a desk. Initially, the aspects of things are characterised by the fact that they can be given vividly in experience, but a more complete analysis reveals aspects to be functionally related to other aspects. Thus perception involves the vivid experience of aspects and the remembrance and anticipation of correlated aspects of a thing. Accordingly, our first principle concerning the physical world is that some physical things exist to which correlated sets of aspects belong which may be given in experience. The second principle is that the structure of things is exhibited in the structure of their aspects. These two principles suffice for a basic theory of the physical world. It is not possible to question the principles, since they are empirically discernible in the procedure of science.

It would accord with a positivist or empiricist philosophy to rest content with the foregoing principles. But traditional theory of knowledge, or epistemology, considers the ultimate relation between a thing and its aspects and their dependence on experience, and consequently yields a metaphysical theory.

The theory which has been favoured traditionally by natural scientific workers is dualism. The physical thing is assumed to be independent of experience and to produce its aspects by acting upon the observer. That aspects belong to a thing means that they are caused by the thing. Since the structure of an effect is determined by that of its cause, the structure of aspects manifests that of things. In contemporary discussion, dualism is sponsored by Sir Arthur Eddington.

Dualism was developed in the seventeenth century by Descartes and Locke. The empiricist criticism of it by Berkeley and Hume yielded subjectivism and phenomenalism. A thing was declared to be the set of its aspects which were assumed to be dependent on experience. Aspects belong to a thing in the sense of being members of the set of aspects constituting the thing; obviously, the structure of aspects exhibits the structure of things. The independence of things of experience is lost, and hence subjectivism and phenomenalism have been rejected by most philosophers.

In recent years, philosophers have made heroic efforts to work out a theory according to which experience directly presents an independent thing. The neo-realists, for example, have conceived of a

thing as a set of aspects which are independent of experience. They thereby seek to retain the advantages of phenomenalism and dualism.

The three theories, dualism, phenomenalism and neo-realism, yield interpretations of the principles that the aspects of a thing belong to it and that the structure of things is exhibited in the structure of aspects. On dualism the two principles are hypotheses, on the two theories which assume direct experience of things the principles are definitions of a thing in terms of its aspects. It is impossible to decide empirically between the several theories, and on this ground the logical positivists would deny meaning to the problem and its solutions.

A position intermediate between the positivist theory which is expressed in our two fundamental principles and the several metaphysical views may be derived from Mach. The essence of a thing is the functional relation between its aspects. This functional relation is the independent feature of the physical things given in experience; the independent reality of the physical world resides in the independence of a system of laws rather than in the independence of substance. Whether one further holds with phenomenalism that aspects are created in experience, or with realism that aspects are merely revealed in experience, seems to be unimportant in that the issue cannot be decided empirically.

V. F. LENZEN.

Department of Physics,
University of California,
Berkeley.
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A Useful Application of the Principle of Heterogonic Growth

I HAVE come upon an interesting example of the way in which the application of the principle of heterogonic growth may simplify an involved problem. A certain measurement y of an organ or part of an organism is said to show heterogonic growth with respect to some standard measurement x of the organism when the equation $y = bx^k$ holds good over a definite period, b and k being constants typical for each particular case¹. Heterogonic growth clearly involves a regularly continuous change of proportions.

This example concerns a well-known and widely-discussed study by the late Prof. Weldon on the shore crab, *Carcinus maenas*². In three different years, 1893, 1895, 1898, he made accurate measurements of frontal width (between the two most anterior 'teeth' on the anterior edge of the carapace) and carapace length, in a large number of young males covering the range 10–15 mm. carapace length, taken from a particular patch of beach in Plymouth Sound. Grouping the data by intervals of 0.2 mm. carapace length, he observed that with increasing size the mean relative frontal width became smaller, and concluded that some selective agency was acting against individuals with a relatively wide frontal aperture, the intensity of selection being assumed to increase with growth. The theory was apparently supported by the asymmetrical curves of distribution of individuals in each group. In the years 1895 and 1898 the frontal width was progressively less at the lowest size and its relative diminution with increase in body size was correspondingly more marked. Selection was assumed to have produced a progressive