

REVIEWS.

The Concept of Nature. By A. N. Whitehead, Sc.D., F.R.S.—
Cambridge University Press, 1920.—Pp. viii + 202.

THIS book, with the exception of the last two chapters, consists of the first course of lectures delivered at Trinity College, Cambridge, under the Turner Benefaction. The general outline of Professor Whitehead's theory of nature will be familiar to readers of the HIBBERT, either from his earlier *Principles of Natural Knowledge* or from the review of that work by the present writer. The main difference between the earlier and the later expositions is that in *The Concept of Nature* detailed mathematical deductions are avoided, and more attention is given to logical and epistemological considerations. Neither book can be dispensed with if Professor Whitehead's views are to be properly understood. The detailed deductions are needed to show that such premises as Whitehead's really do lead to workable definitions of the concepts used by mathematical physics. The epistemological discussions, quite apart from their intrinsic value, which is very great, are needed to show that some such interpretation as Whitehead's is not merely one possible alternative, but is the necessary way of analysing nature if we are to reach results that are intelligible as well as practically useful. In this review I shall confine myself mainly to logical and epistemological points.

It is a fact of observation that we can think about nature without thinking about thought. This remains true even if nature be in some way existentially dependent on the thoughts of ourselves or of God, as many idealists have held. Nature for the present purpose is defined as that whole of which—or of part of which—we become aware in sense-perception. Now, whether all sense-perception involves thought or not, it is certain that it involves a form of apprehension which is not thought, viz. sense-awareness. And it is also a fact of observation that we can think about nature without thinking about sense-awareness. This, again, is true without prejudice to the possibility that nature may in some sense be existentially dependent on the sense-awareness of ourselves or of someone else, as Berkeley held.

The next point, then, is to explain how sense-awareness differs from thought. We often talk of sensing and thinking of the same object, e.g. red. What is the difference? To explain this, Whitehead distinguishes three components in our knowledge of nature, viz. "fact, factors, and entities." Fact is the whole object of sense-awareness, factors are the distinct elements of this whole which also become objects of sense-aware-

ness, entities are "factors in their function as the termini of thought." The difference between sense and thought will therefore rest upon the difference between factors and entities, or on the difference between factors as such and factors treated as entities. Factors are of two different kinds, viz. events, *i.e.* bits of the whole fact which is nature, and objects that are not events, *e.g.* qualities like a definite shade of blue and relations like *between*. The latter are "situated in" the former. Now, any factor can be treated as an entity, and when this is done it is not merely sensed but thought about. An entity is treated as factor when it is merely demonstrated as a bare subject for thought. It is what answers to phrases like *this* and *it*. We of course meet with factors as elements in related wholes. And if they are events there will be qualities situated in them. Nevertheless, in thinking about them we drop the qualities and relations and think of the factor as a bare entity. This does *not* mean that we suppose that in fact it exists without qualities or relations. We do not. We treat the factor which we know to have qualities and to stand in relations as a mere peg on which to hang judgments. In dealing with other people we need to make them treat the factor, which we have turned into an entity, in the same way. This we can sometimes do by mere pointing. Yet generally we have to do it by using a descriptive phrase. Many phrases that appear to be merely demonstrative are elliptical and really involve descriptions. When we say: *That is a queer figure*, we are merely demonstrating. But when we say: *That man is a queer figure*, we mean, *That is a man, and has a queer figure*. The second statement would be contradicted by saying: *That is not a man but a scarecrow*. Thus we notice that when a descriptive phrase is used (*a*) we always do come down to a bare entity denoted by *that*, but (*b*) in order to make another man think of it we have to make an assertion about it which is not the assertion that we are principally intending to convey to him.

Now, Whitehead holds that a misinterpretation of the process by which thought treats factors as entities is the basis of the philosophical view of substance, and that the scientific concept of matter is a half-hearted attempt to combine this philosophic view of substance with the scientific question: What is nature made of? As regards the first point, entities without qualities and relations are regarded as the bearers of qualities and relations, and it is supposed that we only perceive the latter. The truth is that we perceive factors, and simply for purposes of thought treat them as entities. The second point is that science cannot rest in the philosophic notion of substances as entities without qualities or relations, and therefore gives to matter spatio-temporal qualities and relations, but refuses to give it any others. The other qualities are rejected because of the philosophic notion of substance; the spatio-temporal ones are kept because without them matter would be scientifically useless. The difficulties of such a view are not noticed. But clearly, if we only perceive attributes, it is only attributes that we have a right to regard as extended and standing in spatio-temporal relations. If matter be in space and time at all, we cannot identify its space and time with those in which we perceive attributes to be. No doubt the current doctrine of matter includes valuable elements; it expresses real facts such as permanence of mass of chemical constituents. Yet it expresses these facts in a muddled way, and the source of the muddle is the hypostatization of entities.

The second chapter deals with Theories of the Bifurcation of Nature,

and is extremely important. Bifurcation consists in dividing nature into two parts, a causal part—atoms, electrons, light-waves, etc.,—and an apparent part—colours, sounds, etc. The old naïve theory according to which we perceive the attributes of things which are bare substances is not itself a bifurcation theory in this sense. But the moment it is faced with the fact of the transmission of light, sound, etc., it tends to develop into a bifurcation theory. The colours that we do see are “apparent nature,” the vibrations that we do not see are “causal nature”; nature splits up into “the dream and the conjecture,” as Whitehead happily puts it. It seems to me that bifurcation theories are of two different types. Whitehead gives examples of both, and objects to both forms about equally, but he does not explicitly distinguish the two. The first is the theory of psychic additions. This is the view that when causal nature acts on mind, mind responds by creating apparent nature. The theory of primary and secondary qualities is an example of such a view. The second is the theory that when causal nature acts on mind, mind responds, not by creating, but by perceiving apparent nature. This second view can be stated so as to be completely self-consistent. It is most easy to do this on the absolute theory of space and time. Yet in any case it leaves the connection between apparent and causal nature unexplained; it makes causal nature conjectural, since we are never directly aware of it; and so it renders an ascription of spatio-temporal attributes to causal nature a mere far-fetched hypothesis. On both theories the fundamental difficulty is that we are not describing the relations of one bit of nature to another, but are talking of the causal relations between nature and the mind. In the one case we say that causal nature stimulates the mind to create apparent nature; in the other, that it stimulates the mind to perceive apparent nature. The fact is, as Whitehead says, that we do not believe in light-waves because they are just the sort of things that would be likely to stimulate a mind to create or to perceive colours. “The real question is: When red is found in nature, what else is found there also?” What we have to do is simply to exhibit the fundamental entities and relations in nature (*i.e.* the total object of perception), and to be sure that they are adequate to express all the observed facts. It is the inadequacy of the classical concepts used in dealing with nature that has led to bifurcation theories with their illegitimate introduction of the mind as a *deus ex machina*.

The third chapter explicitly deals with Time, but it also contains important principles of wider application. First, it explains what is meant by the notions of empty places and times. When we are aware of a part of nature in sense-perception, only certain features are distinctly discriminated and recognised to contain qualitative peculiarities. But none of these discriminated and qualified events are felt to be complete in themselves. They all refer to something beyond themselves which is not discriminated. The whole of which they are thus recognised to be fragments is a spatio-temporal whole. Now, we can think of other fragments of this whole, as definitely related to the discriminated fragments, without thinking of the particular qualities that reside in these other fragments. Thought of in this way, they are what we mean by places and bits of time. The whole of nature is in fact a spatio-temporal whole, and a bare event is a bit of this, thought of in its position in the whole, but without reference to the special qualities like colour, temperature, hardness, etc., which may reside in it.

Next, the whole of nature divides up into subordinate parts called durations. The content of any specious present, *i.e.* the immediate object of an act of sense-awareness, is a duration. But it contains thinner durations, and is contained in thicker ones which are certainly not within any specious present of ours. The notion of durations is fundamental for Whitehead and is very difficult to grasp. (i.) I think it is clear that the reference to a specious present is not a *definition* of a duration, but only an *example* of one. There are durations which do not, so far as we know, fall within any specious present. (ii.) I am not perfectly clear whether Whitehead regards the peculiar immediacy which belongs to durations that do fall within specious presents as a fact of external nature, or as a "psychic addition." There is no doubt whatever that the existence of durations is regarded by him as a fact of external nature; but this does not, of course, answer the present question. (iii.) Durations are said to be wholes all of whose parts are simultaneous. This sense of simultaneity does not imply "instantaneousness." And it is perfectly compatible with—indeed always coexists with—succession. I do not think that this can be regarded as a definition of durations. It would rather be true to say that Whitehead's sense of simultaneity is defined by reference to durations. Simultaneity, in this sense, is an irreducible *three-term* relation. The events A and B are not, as such, simultaneous; you can only say that they are simultaneous with respect to some duration C. With respect to thinner durations they will not be simultaneous. Time in nature is an expression of the relations between durations; space is an expression of the relations between events in a single duration.

Time is within nature in the sense that the measurable time of physics expresses the relations between durations, and durations are slices of nature. On the other hand, time extends beyond nature, in the sense that our mental acts succeed each other; what was perceived ceases to have immediacy and becomes merely remembered or quite forgotten. But the time in which the mind is cannot be identified with the time-series of nature, because mental events do not have those properties of natural durations which lead to a definition of physical time. Lastly, we must be prepared to recognise as a possibility (and, since Einstein, as a fact) that the whole course of nature contains many alternative time-series, each of which is as good as the rest. The whole course of nature can be analysed equally exhaustively into many different families of durations, just as a cone can equally well be sliced parallel to its base or to one of its generators, and so on. Each family defines a different and equally legitimate time-series.

In Chapter IV. the Method of Extensive Abstraction is explained. There are some improvements on the exposition which was given in *Principles of Natural Knowledge*. The sense in which the properties of an abstractive class of events converge to a definite limit as regards their numerical values, whilst the class itself does not converge to a limit, is made plain. Also the reason for the introduction of primes and antiprimes is explained; they are introduced in order to avoid irritating special cases of merely technical interest. The connection between puncts and event-particles is made clearer, and the useful distinction between the positional, the extrinsic, and the intrinsic properties of an event-particle is carefully pointed out. An event-particle derives its positional quality from the intersecting moments to which it belongs; it derives its intrinsic properties from qualities situated in the events that converge to it; whilst its extrinsic properties

are simply the relations in the convergent series of events that belong to it. The necessity for passing beyond momentary spaces and defining timeless spaces is well brought out at the end of the chapter by the question: "What is meant by saying that Cambridge in the instantaneous space of 10 o'clock is 52 miles from London in the instantaneous space of 11 o'clock?"

The problem of timeless space is dealt with in Chapter V. As readers of the earlier work will know, its solution depends on the relation of "cogredience" between a "percipient event" and its associated duration. These two difficult notions are much more clearly explained in the present work than in its predecessor. In the first place, it is made absolutely plain that the percipient event falls entirely on the side of nature, and in no sense on that of mind. It is roughly the events that constitute the life of the observer's body. Now this, being a factor present in all sense-perception, is apt to be ignored. Sense-perception is *at least* a triadic relation involving the mind, the body, and external events. Cogredience is the relation between a finite event of any kind and a duration, when this event (*a*) lasts just as long as the duration, and (*b*) has a fixed place in the duration. In particular, the percipient event is cogredient with the duration which is the content of a specious present. This simply means that for a duration to be present the events in my body must (*a*) extend through it and (*b*) keep stationary within it, *i.e.* that there must be one sense of *here* just as there is one sense of *now* in the duration. Other events cogredient with this duration are *there* in one definite sense. When the *here* becomes another *here*, the *now* becomes another *now*. Probably the particular duration which is present to us is determined by the percipient event; when the percipient event is succeeded by a new one which is not cogredient with the old duration, a new duration becomes the content of a new specious present. And this duration need not even belong to the same family as the previous one, *i.e.* there may be no third duration which contains both. Obviously cogredience gives us the notion of rest; and from it the notion of movement and of timeless spaces, in which alone movement has a meaning, can be derived. What we see approximates to an instantaneous space. Now there is no movement in an instantaneous space. Yet we seem to see the path (*e.g.* a road) along which an object that we also see is going to move. But this path is in a momentary space, and therefore never will be traversed. The solution of the difficulty is that, if our expectation is fulfilled, the moving object traverses in timeless space that straight line which is "occupied" by the momentary line which approximately is what we see.

Chapter VI., which deals with Congruence, is philosophically a great improvement on the corresponding parts of the *Principles of Natural Knowledge*, though I hardly think that the mathematical statements in it would be intelligible to anyone who had not followed the detailed deduction in the earlier work. It opens with a most illuminating discussion of M. Poincaré's view that measurement is purely conventional. Whitehead first distinguishes identity of numerical measure from congruence of what is measured. The former presupposes the latter. He then points out that, when the axioms for congruence are laid down, there is a whole host of different relations which equally fulfil them. The choice of one rather than another would lead to entirely different judgments as to what is congruent with what. Now, Poincaré's position was that nature gives us

no clue to choosing one relation rather than another. This must be carefully distinguished from the view that we are in fact confined to a small *set* of possible relations, and that we cannot say which of *these* has been chosen, because the resulting differences fall below the limits of observation. The paradox of Poincaré's view is that with all these alternative congruence relations open to us we should in fact have all chosen practically the same relation, as is shown by the almost complete agreement among our judgments as to what is congruent with what. The strength of his position is that, if space were really independent of time, as the classical view holds, there really would be nothing in nature to guide our choice. Whitehead's own position is that there are facts in nature which guide our choice, but they are facts about motion. They thus generate a theory of congruence both for space and for time. We judged that certain spaces and times were congruent long before the laws of motion were heard of; it is therefore absurd to suppose that our choice was guided by a desire to make the laws of motion as simple as possible, and that King Alfred judged that candles took equal times to burn equal lengths "out of a sentimental regard for Galileo, Newton, Euler, and Lagrange."

In the seventh chapter, which deals with Objects, we leave pure space-time, and enter the realm of matter. Objects are characteristics of events; they can exist in many times and places, unlike events themselves which cannot recur. Some objects can be perceived by the senses, but many cannot. All events in nature are situations of objects, but when the objects are imperceptible we call them empty. The general relation between an object and an event is called "ingression." Ingression takes various forms, including "situation" as a special case. Most difficulties about matter arise from three connected kinds of over-simplification:— (i.) The failure to recognise that there are many different types of object. The most important are sense-objects, perceptual objects, and scientific objects. All are equally real. (ii.) The failure to recognise that different kinds of objects are differently related to events, *i.e.* that there are different kinds of ingression. Even objects of the same kind (*e.g.* sense-objects) have different relations of ingression to different events. (iii.) The failure to recognise the existence of irreducible many-term relations. With these over-simplifications the problem of where an object is becomes hopeless; with a less simple-minded theory it becomes soluble. Every scientific object is, in a perfectly definite sense, everywhere. For an electron makes some difference throughout the whole of space and time. Yet it makes more difference to one event than to any others. This is called the event where it is situated. Still, the difference between situation and other kinds of ingression is mainly one of degree. A physical object is a connected set of sense-objects situated in a finite event. As a general rule the same event, or one not far removed from it, is also the situation of a scientific object. Multiple relations are specially needed for dealing with sense-objects. The ingression of a sense-object into an event involves at least (a) an active condition, which is generally an event occupied by a scientific object; (b) passive conditions; these really include the whole of nature, but most obviously include the event in which the sense-object is situated; (c) a percipient event, *i.e.* something going on in our bodies; (d) the event which is its situation. When the events (d) and (a) practically coincide we have normal perception, and the same event is occupied by other sense-objects and therefore by a perceptual object. This is the

general rule, but there are plenty of exceptions. If (*b*) includes an event with the qualities of a mirror, the situation of the sense-object and of the event which is the situation of that scientific object which is the active condition will be widely different. In such a case we do still subconsciously perceive associated sense-objects in the situation of the one actually sensed. Thus this situation contains not merely a sense-object but also a perceptual object. But this perceptual object, being situated in a quite different event from the causal scientific object, cannot be counted as physical. We call it a *delusive* perceptual object. Its ingression in the event in which it is situated is principally due to the mirror and to the perceptual event. For this reason it cannot be perceived from most places, whereas a non-delusive perceptual object can be perceived by practically anyone from practically anywhere.

The book closes with two supplementary lectures, not delivered under the Turner Benefaction. They contain a good summary of the whole theory, and are of special interest in bringing out Professor Whitehead's attitude towards the general theory of relativity which has become so prominent since the *Principles of Natural Knowledge* was written. The position is this. The transformations of the older theory of relativity are deduced by Whitehead from his own principles without any reference to the velocity of light. This is an enormous philosophic advantage. Purely spatio-temporal transformations ought to depend on the nature of space-time as such, and not on the properties of particular kinds of events in space-time. Conversely, Whitehead refuses altogether to regard gravitation as due to the properties of a non-homaloidal space-time. His view is that it is utterly impossible to give any clear meanings to congruence or to motion on such a theory. But he quite recognises that the traditional statement of the law of gravitation must be modified to meet the difficulty that "*the distance between two particles,*" which appears in this statement, has ceased to have any one unambiguous meaning. He states that by using the tensor method he has succeeded in reformulating the law of gravitation, with no nonsense about non-homaloidal spaces, but with the introduction of two different potential functions in place of the single function of the classical theory. Mathematicians and philosophers will eagerly await the publication of this vitally important piece of work.

The thanks rendered in the preface by Professor Whitehead to the Cambridge University Press officials seem to me excessive. No doubt their hearts are in the right place, but they have passed at least six bad mistakes. On p. 51, l. 4, for *sight* read *touch*; p. 86, l. 8, for *external, eternal*; p. 148, l. 4, for *agree, argue*; p. 155, l. 17, for *sense-object, perceptual object*; p. 180, l. 4, for *universely* (a pleasant conceit!), *inversely*; and on p. 188, l. 9, for *by* read *from*. In conclusion, I must say that anyone who has read *Principles of Natural Knowledge* will find his understanding of that book much improved by reading *The Concept of Nature*; and that anyone who has read neither should go at once to his (or her) bookseller and order both.

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