



# **The Concept of Nature**

Alfred North Whitehead

## **CHAPTER I**

### **NATURE AND THOUGHT**

The subject-matter of the Turner lectures is defined by the founder to be ‘the Philosophy of the Sciences and the Relations or Want of Relations between the different Departments of Knowledge.’ It is fitting at the first lecture of this new foundation to dwell for a few moments on the intentions of the donor as expressed in this definition; and I do so the more willingly as I shall thereby be enabled to introduce the topics to which the present course is to be devoted.

We are justified, I think, in taking the second clause of the definition as in part explanatory of the earlier clause. What is the philosophy of the sciences? It is not a bad answer to say that it is the study of the relations between the different departments of knowledge. Then with admirable solicitude for the freedom of learning there is inserted in the definition after the word ‘relations’ the phrase ‘or want of relations.’ A disproof of relations between sciences would in itself constitute a philosophy of the sciences. But we could not dispense either with the earlier or the later clause. It is not every relation between sciences which enters into their philosophy. For example biology and physics are connected by the use of the microscope. Still, I may safely assert that a technical description of the uses of the microscope in biology is not part of the philosophy of the sciences. Again, you cannot abandon the later clause of the definition; namely that referring to the relations between the sciences, without abandoning the explicit reference to an ideal in the absence of which philosophy must languish from lack of intrinsic interest. That ideal is the attainment of some unifying concept which will set in assigned relationships within itself all that there is for knowledge, for feeling, and for emotion. That far off ideal is the motive power of philosophic research; and claims allegiance even as you expel it. The philosophic pluralist is a strict logician; the Hegelian thrives on contradictions by the help of his absolute; the Mohammedan divine bows before the creative will of Allah; and the pragmatist will swallow anything so long as it ‘works.’

The mention of these vast systems and of the age-long controversies from which they spring, warns us to concentrate. Our task is the simpler one of the philosophy of the sciences. Now a science has already a certain unity which is the very reason why that body of knowledge has been instinctively recognised as forming a science. The philosophy of a science is the

endeavour to express explicitly those unifying characteristics which pervade that complex of thoughts and make it to be a science. The philosophy of the sciences—conceived as one subject—is the endeavour to exhibit all sciences as one science, or—in case of defeat—the disproof of such a possibility.

Again I will make a further simplification, and confine attention to the natural sciences, that is, to the sciences whose subject-matter is nature. By postulating a common subject-matter for this group of sciences a unifying philosophy of natural science has been thereby presupposed.

What do we mean by nature? We have to discuss the philosophy of natural science. Natural science is the science of nature. But—What is nature?

Nature is that which we observe in perception through the senses. In this sense-perception we are aware of something which is not thought and which is self-contained for thought. This property of being self-contained for thought lies at the base of natural science. It means that nature can be thought of as a closed system whose mutual relations do not require the expression of the fact that they are thought about.

Thus in a sense nature is independent of thought. By this statement no metaphysical pronouncement is intended. What I mean is that we can think about nature without thinking about thought. I shall say that then we are thinking ‘homogeneously’ about nature.

Of course it is possible to think of nature in conjunction with thought about the fact that nature is thought about. In such a case I shall say that we are thinking ‘heterogeneously’ about nature. In fact during the last few minutes we have been thinking heterogeneously about nature. Natural science is exclusively concerned with homogeneous thoughts about nature.

But sense-perception has in it an element which is not thought. It is a difficult psychological question whether sense-perception involves thought; and if it does involve thought, what is the kind of thought which it necessarily involves. Note that it has been stated above that sense-perception is an awareness of something which is not thought. Namely, nature is not thought. But this is a different question, namely that the fact of sense-perception has a factor which is not thought. I call this factor ‘sense-awareness.’ Accordingly the doctrine that natural science is exclusively concerned with homogeneous thoughts about nature does not immediately carry with it the conclusion that natural science is not concerned with sense-awareness.

However, I do assert this further statement; namely, that though natural science is concerned with nature which is the terminus of sense-perception, it is not concerned with the sense-awareness itself.

I repeat the main line of this argument, and expand it in certain directions.

Thought about nature is different from the sense-perception of nature. Hence the fact of sense-perception has an ingredient or factor which is not thought. I call this ingredient sense-awareness. It is indifferent to my argument whether sense-perception has or has not thought as another ingredient. If sense-perception does not involve thought, then sense-awareness and sense-perception are identical. But the something perceived is perceived as an entity which is the terminus of the sense-awareness, something which for thought is beyond the fact of

that sense-awareness. Also the something perceived certainly does not contain other sense-awarenesses which are different from the sense-awareness which is an ingredient in that perception. Accordingly nature as disclosed in sense-perception is self-contained as against sense-awareness, in addition to being self-contained as against thought. I will also express this self-containedness of nature by saying that nature is closed to mind.

This closure of nature does not carry with it any metaphysical doctrine of the disjunction of nature and mind. It means that in sense-perception nature is disclosed as a complex of entities whose mutual relations are expressible in thought without reference to mind, that is, without reference either to sense-awareness or to thought. Furthermore, I do not wish to be understood as implying that sense-awareness and thought are the only activities which are to be ascribed to mind. Also I am not denying that there are relations of natural entities to mind or minds other than being the termini of the sense-awarenesses of minds. Accordingly I will extend the meaning of the terms 'homogeneous thoughts' and 'heterogeneous thoughts' which have already been introduced. We are thinking 'homogeneously' about nature when we are thinking about it without thinking about thought or about sense-awareness, and we are thinking 'heterogeneously' about nature when we are thinking about it in conjunction with thinking either about thought or about sense-awareness or about both.

I also take the homogeneity of thought about nature as excluding any reference to moral or aesthetic values whose apprehension is vivid in proportion to self-conscious activity. The values of nature are perhaps the key to the metaphysical synthesis of existence. But such a synthesis is exactly what I am not attempting. I am concerned exclusively with the generalisations of widest scope which can be effected respecting that which is known to us as the direct deliverance of sense-awareness.

I have said that nature is disclosed in sense-perception as a complex of entities. It is worth considering what we mean by an entity in this connexion. 'Entity' is simply the Latin equivalent for 'thing' unless some arbitrary distinction is drawn between the words for technical purposes. All thought has to be about things. We can gain some idea of this necessity of things for thought by examination of the structure of a proposition.

Let us suppose that a proposition is being communicated by an expositor to a recipient. Such a proposition is composed of phrases; some of these phrases may be demonstrative and others may be descriptive.

By a demonstrative phrase I mean a phrase which makes the recipient aware of an entity in a way which is independent of the particular demonstrative phrase. You will understand that I am here using 'demonstration' in the non-logical sense, namely in the sense in which a lecturer demonstrates by the aid of a frog and a microscope the circulation of the blood for an elementary class of medical students. I will call such demonstration 'speculative' demonstration, remembering Hamlet's use of the word 'speculation' when he says,

There is no speculation in those eyes.

Thus a demonstrative phrase demonstrates an entity speculatively. It may happen that the expositor has meant some other entity—namely, the phrase demonstrates to him an entity which is diverse from the entity which it demonstrates to the recipient. In that case there is confusion; for there are two diverse propositions, namely the proposition for the expositor and the proposition for the recipient. I put this possibility aside as irrelevant for our discussion, though in practice it may be difficult for two persons to concur in the consideration of exactly the same proposition, or even for one person to have determined exactly the proposition which he is considering.

Again the demonstrative phrase may fail to demonstrate any entity. In that case there is no proposition for the recipient. I think that we may assume (perhaps rashly) that the expositor knows what he means.

A demonstrative phrase is a gesture. It is not itself a constituent of the proposition, but the entity which it demonstrates is such a constituent. You may quarrel with a demonstrative phrase as in some way obnoxious to you; but if it demonstrates the right entity, the proposition is unaffected though your taste may be offended. This suggestiveness of the phraseology is part of the literary quality of the sentence which conveys the proposition. This is because a sentence directly conveys one proposition, while in its phraseology it suggests a penumbra of other propositions charged with emotional value. We are now talking of the one proposition directly conveyed in any phraseology.

This doctrine is obscured by the fact that in most cases what is in form a mere part of the demonstrative gesture is in fact a part of the proposition which it is desired directly to convey. In such a case we will call the phraseology of the proposition elliptical. In ordinary intercourse the phraseology of nearly all propositions is elliptical.

Let us take some examples. Suppose that the expositor is in London, say in Regent's Park and in Bedford College, the great women's college which is situated in that park. He is speaking in the college hall and he says,

‘This college building is commodious.’

The phrase ‘this college building’ is a demonstrative phrase. Now suppose the recipient answers,

‘This is not a college building, it is the lion-house in the Zoo.’

Then, provided that the expositor's original proposition has not been couched in elliptical phraseology, the expositor sticks to his original proposition when he replies,

‘Anyhow, *it* is commodious.’

Note that the recipient's answer accepts the speculative demonstration of the phrase 'This college building.' He does not say, 'What do you mean?' He accepts the phrase as demonstrating an entity, but declares that same entity to be the lion-house in the Zoo. In his reply, the expositor in his turn recognises the success of his original gesture as a speculative demonstration, and waives the question of the suitability of its mode of suggestiveness with an 'anyhow.' But he is now in a position to repeat the original proposition with the aid of a demonstrative gesture robbed of any suggestiveness, suitable or unsuitable, by saying,

'It is commodious.'

The '*it*' of this final statement presupposes that thought has seized on the entity as a bare objective for consideration.

We confine ourselves to entities disclosed in sense-awareness. The entity is so disclosed as a relatum in the complex which is nature. It dawns on an observer because of its relations; but it is an objective for thought in its own bare individuality. Thought cannot proceed otherwise; namely, it cannot proceed without the ideal bare '*it*' which is speculatively demonstrated. This setting up of the entity as a bare objective does not ascribe to it an existence apart from the complex in which it has been found by sense-perception. The '*it*' for thought is essentially a relatum for sense-awareness.

The chances are that the dialogue as to the college building takes another form. Whatever the expositor originally meant, he almost certainly now takes his former statement as couched in elliptical phraseology, and assumes that he was meaning,

'This is a college building and is commodious.'

Here the demonstrative phrase or the gesture, which demonstrates the '*it*' which is commodious, has now been reduced to '*this*'; and the attenuated phrase, under the circumstances in which it is uttered, is sufficient for the purpose of correct demonstration. This brings out the point that the verbal form is never the whole phraseology of the proposition; this phraseology also includes the general circumstances of its production. Thus the aim of a demonstrative phrase is to exhibit a definite '*it*' as a bare objective for thought; but the *modus operandi* of a demonstrative phrase is to produce an awareness of the entity as a particular relatum in an auxiliary complex, chosen merely for the sake of the speculative demonstration and irrelevant to the proposition. For example, in the above dialogue, colleges and buildings, as related to the '*it*' speculatively demonstrated by the phrase 'this college building,' set that '*it*' in an auxiliary complex which is irrelevant to the proposition

'It is commodious.'

Of course in language every phrase is invariably highly elliptical. Accordingly the sentence

‘This college building is commodious’

means probably

‘This college building is commodious as a college building.’

But it will be found that in the above discussion we can replace ‘commodious’ by ‘commodious as a college building’ without altering our conclusion; though we can guess that the recipient, who thought he was in the lion-house of the Zoo, would be less likely to assent to.

‘Anyhow, it is commodious as a college building.’

A more obvious instance of elliptical phraseology arises if the expositor should address the recipient with the remark,

‘That criminal is your friend.’

The recipient might answer,

‘He is my friend and you are insulting.’

Here the recipient assumes that the phrase ‘That criminal’ is elliptical and not merely demonstrative. In fact, pure demonstration is impossible though it is the ideal of thought. This practical impossibility of pure demonstration is a difficulty which arises in the communication of thought and in the retention of thought. Namely, a proposition about a particular factor in nature can neither be expressed to others nor retained for repeated consideration without the aid of auxiliary complexes which are irrelevant to it.

I now pass to descriptive phrases. The expositor says,

‘A college in Regent’s Park is commodious.’

The recipient knows Regent’s Park well. The phrase ‘A college in Regent’s Park’ is descriptive for him. If its phraseology is not elliptical, which in ordinary life it certainly will be in some way or other, this proposition simply means,

‘There is an entity which is a college building in Regent’s Park and is commodious.’

If the recipient rejoins,

‘The lion-house in the Zoo is the only commodious building in Regent’s Park,’

he now contradicts the expositor, on the assumption that a lion-house in a Zoo is not a college building.

Thus whereas in the first dialogue the recipient merely quarrelled with the expositor without contradicting him, in this dialogue he contradicts him. Thus a descriptive phrase is part of the proposition which it helps to express, whereas a demonstrative phrase is not part of the proposition which it helps to express.

Again the expositor might be standing in Green Park—where there are no college buildings—and say,

‘This college building is commodious.’

Probably no proposition will be received by the recipient because the demonstrative phrase,

‘This college building’

has failed to demonstrate owing to the absence of the background of sense-awareness which it presupposes.

But if the expositor had said,

‘A college building in Green Park is commodious,’

the recipient would have received a proposition, but a false one.

Language is usually ambiguous and it is rash to make general assertions as to its meanings. But phrases which commence with ‘this’ or ‘that’ are usually demonstrative, whereas phrases which commence with ‘the’ or ‘a’ are often descriptive. In studying the theory of propositional expression it is important to remember the wide difference between the analogous modest words ‘this’ and ‘that’ on the one hand and ‘a’ and ‘the’ on the other hand. The sentence

‘The college building in Regent’s Park is commodious’

means, according to the analysis first made by Bertrand Russell, the proposition,

‘There is an entity which (i) is a college building in Regent’s Park and (ii) is commodious and (iii) is such that any college building in Regent’s Park is identical with it.’

The descriptive character of the phrase ‘The college building in Regent’s Park’ is thus evident. Also the proposition is denied by the denial of any one of its three component clauses or by the denial of any combination of the component clauses. If we had substituted ‘Green Park’ for ‘Regent’s Park’ a false proposition would have resulted. Also the erection of a second college in Regent’s Park would make the proposition false, though in ordinary life common sense would politely treat it as merely ambiguous.

‘The Iliad’ for a classical scholar is usually a demonstrative phrase; for it demonstrates to him a well-known poem. But for the majority of mankind the phrase is descriptive, namely, it is synonymous with ‘The poem named “the Iliad”.’

Names may be either demonstrative or descriptive phrases. For example ‘Homer’ is for us a descriptive phrase, namely, the word with some slight difference in suggestiveness means ‘The man who wrote the Iliad.’

This discussion illustrates that thought places before itself bare objectives, entities as we call them, which the thinking clothes by expressing their mutual relations. Sense-awareness discloses fact with factors which are the entities for thought. The separate distinction of an entity in thought is not a metaphysical assertion, but a method of procedure necessary for the finite expression of individual propositions. Apart from entities there could be no finite truths; they are the means by which the infinitude of irrelevance is kept out of thought.

To sum up: the termini for thought are entities, primarily with bare individuality, secondarily with properties and relations ascribed to them in the procedure of thought; the termini for sense-awareness are factors in the fact of nature, primarily relata and only secondarily discriminated as distinct individualities.

No characteristic of nature which is immediately posited for knowledge by sense-awareness can be explained. It is impenetrable by thought, in the sense that its peculiar essential character which enters into experience by sense-awareness is for thought merely the guardian of its individuality as a bare entity. Thus for thought ‘red’ is merely a definite entity, though for awareness ‘red’ has the content of its individuality. The transition from the ‘red’ of awareness to the ‘red’ of thought is accompanied by a definite loss of content, namely by the transition from the factor ‘red’ to the entity ‘red.’ This loss in the transition to thought is compensated by the fact that thought is communicable whereas sense-awareness is incommunicable.

Thus there are three components in our knowledge of nature, namely, fact, factors, and entities. Fact is the undifferentiated terminus of sense-awareness; factors are termini of sense-awareness, differentiated as elements of fact; entities are factors in their function as the termini of thought. The entities thus spoken of are natural entities. Thought is wider than nature, so that there are entities for thought which are not natural entities.

When we speak of nature as a complex of related entities, the ‘complex’ is fact as an entity for thought, to whose bare individuality is ascribed the property of embracing in its complexity the natural entities. It is our business to analyse this conception and in the course of the analysis space and time should appear. Evidently the relations holding between natural entities are



themselves natural entities, namely they are also factors of fact, there for sense-awareness. Accordingly the structure of the natural complex can never be completed in thought, just as the factors of fact can never be exhausted in sense-awareness. Unexhaustiveness is an essential character of our knowledge of nature. Also nature does not exhaust the matter for thought, namely there are thoughts which would not occur in any homogeneous thinking about nature.

The question as to whether sense-perception involves thought is largely verbal. If sense-perception involves a cognition of individuality abstracted from the actual position of the entity as a factor in fact, then it undoubtedly does involve thought. But if it is conceived as sense-awareness of a factor in fact competent to evoke emotion and purposeful action without further cognition, then it does not involve thought. In such a case the terminus of the sense-awareness is something for mind, but nothing for thought. The sense-perception of some lower forms of life may be conjectured to approximate to this character habitually. Also occasionally our own sense-perception in moments when thought-activity has been lulled to quiescence is not far off the attainment of this ideal limit.

The process of discrimination in sense-awareness has two distinct sides. There is the discrimination of fact into parts, and the discrimination of any part of fact as exhibiting relations to entities which are not parts of fact though they are ingredients in it. Namely the immediate fact for awareness is the whole occurrence of nature. It is nature as an event present for sense-awareness, and essentially passing. There is no holding nature still and looking at it. We cannot redouble our efforts to improve our knowledge of the terminus of our present sense-awareness; it is our subsequent opportunity in subsequent sense-awareness which gains the benefit of our good resolution. Thus the ultimate fact for sense-awareness is an event. This whole event is discriminated by us into partial events. We are aware of an event which is our bodily life, of an event which is the course of nature within this room, and of a vaguely perceived aggregate of other partial events. This is the discrimination in sense-awareness of fact into parts.

I shall use the term 'part' in the arbitrarily limited sense of an event which is part of the whole fact disclosed in awareness.

Sense-awareness also yields to us other factors in nature which are not events. For example, sky-blue is seen as situated in a certain event. This relation of situation requires further discussion which is postponed to a later lecture. My present point is that sky-blue is found in nature with a definite implication in events, but is not an event itself. Accordingly in addition to events, there are other factors in nature directly disclosed to us in sense-awareness. The conception in thought of all the factors in nature as distinct entities with definite natural relations is what I have in another place called the 'diversification of nature.'

There is one general conclusion to be drawn from the foregoing discussion. It is that the first task of a philosophy of science should be some general classification of the entities disclosed to us in sense-perception.

Among the examples of entities in addition to 'events' which we have used for the purpose of illustration are the buildings of Bedford College, Homer, and sky-blue. Evidently these are

very different sorts of things; and it is likely that statements which are made about one kind of entity will not be true about other kinds. If human thought proceeded with the orderly method which abstract logic would suggest to it, we might go further and say that a classification of natural entities should be the first step in science itself. Perhaps you will be inclined to reply that this classification has already been effected, and that science is concerned with the adventures of material entities in space and time.

The history of the doctrine of matter has yet to be written. It is the history of the influence of Greek philosophy on science. That influence has issued in one long misconception of the metaphysical status of natural entities. The entity has been separated from the factor which is the terminus of sense-awareness. It has become the substratum for that factor, and the factor has been degraded into an attribute of the entity. In this way a distinction has been imported into nature which is in truth no distinction at all. A natural entity is merely a factor of fact, considered in itself. Its disconnexion from the complex of fact is a mere abstraction. It is not the substratum of the factor, but the very factor itself as bared in thought. Thus what is a mere procedure of mind in the translation of sense-awareness into discursive knowledge has been transmuted into a fundamental character of nature. In this way matter has emerged as being the metaphysical substratum of its properties, and the course of nature is interpreted as the history of matter.

Plato and Aristotle found Greek thought preoccupied with the quest for the simple substances in terms of which the course of events could be expressed. We may formulate this state of mind in the question, What is nature made of? The answers which their genius gave to this question, and more particularly the concepts which underlay the terms in which they framed their answers, have determined the unquestioned presuppositions as to time, space and matter which have reigned in science.

In Plato the forms of thought are more fluid than in Aristotle, and therefore, as I venture to think, the more valuable. Their importance consists in the evidence they yield of cultivated thought about nature before it had been forced into a uniform mould by the long tradition of scientific philosophy. For example in the *Timaeus* there is a presupposition, somewhat vaguely expressed, of a distinction between the general becoming of nature and the measurable time of nature. In a later lecture I have to distinguish between what I call the passage of nature and particular time-systems which exhibit certain characteristics of that passage. I will not go so far as to claim Plato in direct support of this doctrine, but I do think that the sections of the *Timaeus* which deal with time become clearer if my distinction is admitted.

This is however a digression. I am now concerned with the origin of the scientific doctrine of matter in Greek thought. In the *Timaeus* Plato asserts that nature is made of fire and earth with air and water as intermediate between them, so that 'as fire is to air so is air to water, and as air is to water so is water to earth.' He also suggests a molecular hypothesis for these four elements. In this hypothesis everything depends on the shape of the atoms; for earth it is cubical and for fire it is pyramidal. To-day physicists are again discussing the structure of the atom, and its

shape is no slight factor in that structure. Plato's guesses read much more fantastically than does Aristotle's systematic analysis; but in some ways they are more valuable. The main outline of his ideas is comparable with that of modern science. It embodies concepts which any theory of natural philosophy must retain and in some sense must explain. Aristotle asked the fundamental question, What do we mean by 'substance'? Here the reaction between his philosophy and his logic worked very unfortunately. In his logic, the fundamental type of affirmative proposition is the attribution of a predicate to a subject. Accordingly, amid the many current uses of the term 'substance' which he analyses, he emphasises its meaning as 'the ultimate substratum which is no longer predicated of anything else.'

The unquestioned acceptance of the Aristotelian logic has led to an ingrained tendency to postulate a substratum for whatever is disclosed in sense-awareness, namely, to look below what we are aware of for the substance in the sense of the 'concrete thing.' This is the origin of the modern scientific concept of matter and of ether, namely they are the outcome of this insistent habit of postulation.

Accordingly ether has been invented by modern science as the substratum of the events which are spread through space and time beyond the reach of ordinary ponderable matter. Personally, I think that predication is a muddled notion confusing many different relations under a convenient common form of speech. For example, I hold that the relation of green to a blade of grass is entirely different from the relation of green to the event which is the life history of that blade for some short period, and is different from the relation of the blade to that event. In a sense I call the event the situation of the green, and in another sense it is the situation of the blade. Thus in one sense the blade is a character or property which can be predicated of the situation, and in another sense the green is a character or property of the same event which is also its situation. In this way the predication of properties veils radically different relations between entities.

Accordingly 'substance,' which is a correlative term to 'predication,' shares in the ambiguity. If we are to look for substance anywhere, I should find it in events which are in some sense the ultimate substance of nature.

Matter, in its modern scientific sense, is a return to the Ionian effort to find in space and time some stuff which composes nature. It has a more refined signification than the early guesses at earth and water by reason of a certain vague association with the Aristotelian idea of substance.

Earth, water, air, fire, and matter, and finally ether are related in direct succession so far as concerns their postulated characters of ultimate substrata of nature. They bear witness to the undying vitality of Greek philosophy in its search for the ultimate entities which are the factors of the fact disclosed in sense-awareness. This search is the origin of science.

The succession of ideas starting from the crude guesses of the early Ionian thinkers and ending in the nineteenth century ether reminds us that the scientific doctrine of matter is really a hybrid through which philosophy passed on its way to the refined Aristotelian concept of substance and to which science returned as it reacted against philosophic abstractions. Earth,

fire, and water in the Ionic philosophy and the shaped elements in the *Timaeus* are comparable to the matter and ether of modern scientific doctrine. But substance represents the final philosophic concept of the substratum which underlies any attribute. Matter (in the scientific sense) is already in space and time. Thus matter represents the refusal to think away spatial and temporal characteristics and to arrive at the bare concept of an individual entity. It is this refusal which has caused the muddle of importing the mere procedure of thought into the fact of nature. The entity, bared of all characteristics except those of space and time, has acquired a physical status as the ultimate texture of nature; so that the course of nature is conceived as being merely the fortunes of matter in its adventure through space.

Thus the origin of the doctrine of matter is the outcome of uncritical acceptance of space and time as external conditions for natural existence. By this I do not mean that any doubt should be thrown on facts of space and time as ingredients in nature. What I do mean is 'the unconscious presupposition of space and time as being that within which nature is set.' This is exactly the sort of presupposition which tinges thought in any reaction against the subtlety of philosophical criticism. My theory of the formation of the scientific doctrine of matter is that first philosophy illegitimately transformed the bare entity, which is simply an abstraction necessary for the method of thought, into the metaphysical substratum of these factors in nature which in various senses are assigned to entities as their attributes; and that, as a second step, scientists (including philosophers who were scientists) in conscious or unconscious ignorance of philosophy presupposed this substratum, *qua* substratum for attributes, as nevertheless in time and space.

This is surely a muddle. The whole being of substance is as a substratum for attributes. Thus time and space should be attributes of the substance. This they palpably are not, if the matter be the substance of nature, since it is impossible to express spatio-temporal truths without having recourse to relations involving relata other than bits of matter. I waive this point however, and come to another. It is not the substance which is in space, but the attributes. What we find in space are the red of the rose and the smell of the jasmine and the noise of cannon. We have all told our dentists where our toothache is. Thus space is not a relation between substances, but between attributes.

Thus even if you admit that the adherents of substance can be allowed to conceive substance as matter, it is a fraud to slip substance into space on the plea that space expresses relations between substances. On the face of it space has nothing to do with substances, but only with their attributes. What I mean is, that if you choose—as I think wrongly—to construe our experience of nature as an awareness of the attributes of substances, we are by this theory precluded from finding any analogous direct relations between substances as disclosed in our experience. What we do find are relations between the attributes of substances. Thus if matter is looked on as substance in space, the space in which it finds itself has very little to do with the space of our experience.

The above argument has been expressed in terms of the relational theory of space. But

if space be absolute—namely, if it have a being independent of things in it—the course of the argument is hardly changed. For things in space must have a certain fundamental relation to space which we will call occupation. Thus the objection that it is the attributes which are observed as related to space, still holds.

The scientific doctrine of matter is held in conjunction with an absolute theory of time. The same arguments apply to the relations between matter and time as apply to the relations between space and matter. There is however (in the current philosophy) a difference in the connexions of space with matter from those of time with matter, which I will proceed to explain.

Space is not merely an ordering of material entities so that any one entity bears certain relations to other material entities. The occupation of space impresses a certain character on each material entity in itself. By reason of its occupation of space matter has extension. By reason of its extension each bit of matter is divisible into parts, and each part is a numerically distinct entity from every other such part. Accordingly it would seem that every material entity is not really one entity. It is an essential multiplicity of entities. There seems to be no stopping this dissociation of matter into multiplicities short of finding each ultimate entity occupying one individual point. This essential multiplicity of material entities is certainly not what is meant by science, nor does it correspond to anything disclosed in sense-awareness. It is absolutely necessary that at a certain stage in this dissociation of matter a halt should be called, and that the material entities thus obtained should be treated as units. The stage of arrest may be arbitrary or may be set by the characteristics of nature; but all reasoning in science ultimately drops its space-analysis and poses to itself the problem, 'Here is one material entity, what is happening to it as a unit entity?' Yet this material entity is still retaining its extension, and as thus extended is a mere multiplicity. Thus there is an essential atomic property in nature which is independent of the dissociation of extension. There is something which in itself is one, and which is more than the logical aggregate of entities occupying points within the volume which the unit occupies. Indeed we may well be sceptical as to these ultimate entities at points, and doubt whether there are any such entities at all. They have the suspicious character that we are driven to accept them by abstract logic and not by observed fact.

Time (in the current philosophy) does not exert the same disintegrating effect on matter which occupies it. If matter occupies a duration of time, the whole matter occupies every part of that duration. Thus the connexion between matter and time differs from the connexion between matter and space as expressed in current scientific philosophy. There is obviously a greater difficulty in conceiving time as the outcome of relations between different bits of matter than there is in the analogous conception of space. At an instant distinct volumes of space are occupied by distinct bits of matter. Accordingly there is so far no intrinsic difficulty in conceiving that space is merely the resultant of relations between the bits of matter. But in the one-dimensional time the same bit of matter occupies different portions of time. Accordingly time would have to be expressible in terms of the relations of a bit of matter with itself. My own view is a belief in the relational theory both of space and of time, and of disbelief in

the current form of the relational theory of space which exhibits bits of matter as the relata for spatial relations. The true relata are events. The distinction which I have just pointed out between time and space in their connexion with matter makes it evident that any assimilation of time and space cannot proceed along the traditional line of taking matter as a fundamental element in space-formation.

The philosophy of nature took a wrong turn during its development by Greek thought. This erroneous presupposition is vague and fluid in Plato's *Timaeus*. The general groundwork of the thought is still uncommitted and can be construed as merely lacking due explanation and the guarding emphasis. But in Aristotle's exposition the current conceptions were hardened and made definite so as to produce a faulty analysis of the relation between the matter and the form of nature as disclosed in sense-awareness. In this phrase the term 'matter' is not used in its scientific sense.

I will conclude by guarding myself against a misapprehension. It is evident that the current doctrine of matter enshrines some fundamental law of nature. Any simple illustration will exemplify what I mean. For example, in a museum some specimen is locked securely in a glass case. It stays there for years: it loses its colour, and perhaps falls to pieces. But it is the same specimen; and the same chemical elements and the same quantities of those elements are present within the case at the end as were present at the beginning. Again the engineer and the astronomer deal with the motions of real permanences in nature. Any theory of nature which for one moment loses sight of these great basic facts of experience is simply silly. But it is permissible to point out that the scientific expression of these facts has become entangled in a maze of doubtful metaphysics; and that, when we remove the metaphysics and start afresh on an unprejudiced survey of nature, a new light is thrown on many fundamental concepts which dominate science and guide the progress of research.

## **CHAPTER II**

### **THEORIES OF THE BIFURCATION OF NATURE**

In my previous lecture I criticised the concept of matter as the substance whose attributes we perceive. This way of thinking of matter is, I think, the historical reason for its introduction into science, and is still the vague view of it at the background of our thoughts which makes the current scientific doctrine appear so obvious. Namely we conceive ourselves as perceiving attributes of things, and bits of matter are the things whose attributes we perceive.

In the seventeenth century the sweet simplicity of this aspect of matter received a rude shock. The transmission doctrines of science were then in process of elaboration and by the end of the century were unquestioned, though their particular forms have since been modified. The establishment of these transmission theories marks a turning point in the relation between science and philosophy. The doctrines to which I am especially alluding are the theories of light and sound. I have no doubt that the theories had been vaguely floating about before as

obvious suggestions of common sense; for nothing in thought is ever completely new. But at that epoch they were systematised and made exact, and their complete consequences were ruthlessly deduced. It is the establishment of this procedure of taking the consequences seriously which marks the real discovery of a theory. Systematic doctrines of light and sound as being something proceeding from the emitting bodies were definitely established, and in particular the connexion of light with colour was laid bare by Newton.

The result completely destroyed the simplicity of the 'substance and attribute' theory of perception. What we see depends on the light entering the eye. Furthermore we do not even perceive what enters the eye. The things transmitted are waves or—as Newton thought—minute particles, and the things seen are colours. Locke met this difficulty by a theory of primary and secondary qualities. Namely, there are some attributes of the matter which we do perceive. These are the primary qualities, and there are other things which we perceive, such as colours, which are not attributes of matter, but are perceived by us as if they were such attributes. These are the secondary qualities of matter.

Why should we perceive secondary qualities? It seems an extremely unfortunate arrangement that we should perceive a lot of things that are not there. Yet this is what the theory of secondary qualities in fact comes to. There is now reigning in philosophy and in science an apathetic acquiescence in the conclusion that no coherent account can be given of nature as it is disclosed to us in sense-awareness, without dragging in its relations to mind. The modern account of nature is not, as it should be, merely an account of what the mind knows of nature; but it is also confused with an account of what nature does to the mind. The result has been disastrous both to science and to philosophy, but chiefly to philosophy. It has transformed the grand question of the relations between nature and mind into the petty form of the interaction between the human body and mind.

Berkeley's polemic against matter was based on this confusion introduced by the transmission theory of light. He advocated, rightly as I think, the abandonment of the doctrine of matter in its present form. He had however nothing to put in its place except a theory of the relation of finite minds to the divine mind.

But we are endeavouring in these lectures to limit ourselves to nature itself and not to travel beyond entities which are disclosed in sense-awareness.

Percipience in itself is taken for granted. We consider indeed conditions for percipience, but only so far as those conditions are among the disclosures of perception. We leave to metaphysics the synthesis of the knower and the known. Some further explanation and defence of this position is necessary, if the line of argument of these lectures is to be comprehensible.

The immediate thesis for discussion is that any metaphysical interpretation is an illegitimate importation into the philosophy of natural science. By a metaphysical interpretation I mean any discussion of the how (beyond nature) and of the why (beyond nature) of thought and sense-awareness. In the philosophy of science we seek the general notions which apply to nature, namely, to what we are aware of in perception. It is the philosophy of the thing perceived, and

it should not be confused with the metaphysics of reality of which the scope embraces both perceiver and perceived. No perplexity concerning the object of knowledge can be solved by saying that there is a mind knowing it

In other words, the ground taken is this: sense-awareness is an awareness of something. What then is the general character of that something of which we are aware? We do not ask about the percipient or about the process, but about the perceived. I emphasise this point because discussions on the philosophy of science are usually extremely metaphysical—in my opinion, to the great detriment of the subject.

The recourse to metaphysics is like throwing a match into the powder magazine. It blows up the whole arena. This is exactly what scientific philosophers do when they are driven into a corner and convicted of incoherence. They at once drag in the mind and talk of entities in the mind or out of the mind as the case may be. For natural philosophy everything perceived is in nature. We may not pick and choose. For us the red glow of the sunset should be as much part of nature as are the molecules and electric waves by which men of science would explain the phenomenon. It is for natural philosophy to analyse how these various elements of nature are connected.

In making this demand I conceive myself as adopting our immediate instinctive attitude towards perceptual knowledge which is only abandoned under the influence of theory. We are instinctively willing to believe that by due attention, more can be found in nature than that which is observed at first sight. But we will not be content with less. What we ask from the philosophy of science is some account of the coherence of things perceptively known.

This means a refusal to countenance any theory of psychic additions to the object known in perception. For example, what is given in perception is the green grass. This is an object which we know as an ingredient in nature. The theory of psychic additions would treat the greenness as a psychic addition furnished by the perceiving mind, and would leave to nature merely the molecules and the radiant energy which influence the mind towards that perception. My argument is that this dragging in of the mind as making additions of its own to the thing posited for knowledge by sense-awareness is merely a way of shirking the problem of natural philosophy. That problem is to discuss the relations *inter se* of things known, abstracted from the bare fact that they are known. Natural philosophy should never ask, what is in the mind and what is in nature. To do so is a confession that it has failed to express relations between things perceptively known, namely to express those natural relations whose expression is natural philosophy. It may be that the task is too hard for us, that the relations are too complex and too various for our apprehension, or are too trivial to be worth the trouble of exposition. It is indeed true that we have gone but a very small way in the adequate formulation of such relations. But at least do not let us endeavour to conceal failure under a theory of the byplay of the perceiving mind.

What I am essentially protesting against is the bifurcation of nature into two systems of reality, which, in so far as they are real, are real in different senses. One reality would be the



entities such as electrons which are the study of speculative physics. This would be the reality which is there for knowledge; although on this theory it is never known. For what is known is the other sort of reality, which is the byplay of the mind. Thus there would be two natures, one is the conjecture and the other is the dream.

Another way of phrasing this theory which I am arguing against is to bifurcate nature into two divisions, namely into the nature apprehended in awareness and the nature which is the cause of awareness. The nature which is the fact apprehended in awareness holds within it the greenness of the trees, the song of the birds, the warmth of the sun, the hardness of the chairs, and the feel of the velvet. The nature which is the cause of awareness is the conjectured system of molecules and electrons which so affects the mind as to produce the awareness of apparent nature. The meeting point of these two natures is the mind, the causal nature being influent and the apparent nature being effluent.

There are four questions which at once suggest themselves for discussion in connexion with this bifurcation theory of nature. They concern (i) causality, (ii) time, (iii) space, and (iv) delusions. These questions are not really separable. They merely constitute four distinct starting points from which to enter upon the discussion of the theory.

Causal nature is the influence on the mind which is the cause of the effluence of apparent nature from the mind. This conception of causal nature is not to be confused with the distinct conception of one part of nature as being the cause of another part. For example, the burning of the fire and the passage of heat from it through intervening space is the cause of the body, its nerves and its brain, functioning in certain ways. But this is not an action of nature on the mind. It is an interaction within nature. The causation involved in this interaction is causation in a different sense from the influence of this system of bodily interactions within nature on the alien mind which thereupon perceives redness and warmth.

The bifurcation theory is an attempt to exhibit natural science as an investigation of the cause of the fact of knowledge. Namely, it is an attempt to exhibit apparent nature as an effluent from the mind because of causal nature. The whole notion is partly based on the implicit assumption that the mind can only know that which it has itself produced and retains in some sense within itself, though it requires an exterior reason both as originating and as determining the character of its activity. But in considering knowledge we should wipe out all these spatial metaphors, such as 'within the mind' and 'without the mind.' Knowledge is ultimate. There can be no explanation of the 'why' of knowledge; we can only describe the 'what' of knowledge. Namely we can analyse the content and its internal relations, but we cannot explain why there is knowledge. Thus causal nature is a metaphysical chimera; though there is need of a metaphysics whose scope transcends the limitation to nature. The object of such a metaphysical science is not to explain knowledge, but exhibit in its utmost completeness our concept of reality.

However, we must admit that the causality theory of nature has its strong suit. The reason why the bifurcation of nature is always creeping back into scientific philosophy is the extreme difficulty of exhibiting the perceived redness and warmth of the fire in one system of relations

with the agitated molecules of carbon and oxygen, with the radiant energy from them, and with the various functionings of the material body. Unless we produce the all-embracing relations, we are faced with a bifurcated nature; namely, warmth and redness on one side, and molecules, electrons and ether on the other side. Then the two factors are explained as being respectively the cause and the mind's reaction to the cause.

Time and space would appear to provide these all-embracing relations which the advocates of the philosophy of the unity of nature require. The perceived redness of the fire and the warmth are definitely related in time and in space to the molecules of the fire and the molecules of the body.

It is hardly more than a pardonable exaggeration to say that the determination of the meaning of nature reduces itself principally to the discussion of the character of time and the character of space. In succeeding lectures I shall explain my own view of time and space. I shall endeavour to show that they are abstractions from more concrete elements of nature, namely, from events. The discussion of the details of the process of abstraction will exhibit time and space as interconnected, and will finally lead us to the sort of connexions between their measurements which occur in the modern theory of electromagnetic relativity. But this is anticipating our subsequent line of development. At present I wish to consider how the ordinary views of time and space help, or fail to help, in unifying our conception of nature.

First, consider the absolute theories of time and space. We are to consider each, namely both time and space, to be a separate and independent system of entities, each system known to us in itself and for itself concurrently with our knowledge of the events of nature. Time is the ordered succession of durationless instants; and these instants are known to us merely as the relata in the serial relation which is the time-ordering relation, and the time-ordering relation is merely known to us as relating the instants. Namely, the relation and the instants are jointly known to us in our apprehension of time, each implying the other.

This is the absolute theory of time. Frankly, I confess that it seems to me to be very unpalatable. I cannot in my own knowledge find anything corresponding to the bare time of the absolute theory. Time is known to me as an abstraction from the passage of events. The fundamental fact which renders this abstraction possible is the passing of nature, its development, its creative advance, and combined with this fact is another characteristic of nature, namely the extensive relation between events. These two facts, namely the passage of events and the extension of events over each other, are in my opinion the qualities from which time and space originate as abstractions. But this is anticipating my own later speculations.

Meanwhile, returning to the absolute theory, we are to suppose that time is known to us independently of any events in time. What happens in time occupies time. This relation of events to the time occupied, namely this relation of occupation, is a fundamental relation of nature to time. Thus the theory requires that we are aware of two fundamental relations, the time-ordering relation between instants, and the time-occupation relation between instants of time and states of nature which happen at those instants.

There are two considerations which lend powerful support to the reigning theory of absolute time. In the first place time extends beyond nature. Our thoughts are in time. Accordingly it seems impossible to derive time merely from relations between elements of nature. For in that case temporal relations could not relate thoughts. Thus, to use a metaphor, time would apparently have deeper roots in reality than has nature. For we can imagine thoughts related in time without any perception of nature. For example we can imagine one of Milton's angels with thoughts succeeding each other in time, who does not happen to have noticed that the Almighty has created space and set therein a material universe. As a matter of fact I think that Milton set space on the same absolute level as time. But that need not disturb the illustration. In the second place it is difficult to derive the true serial character of time from the relative theory. Each instant is irrevocable. It can never recur by the very character of time. But if on the relative theory an instant of time is simply the state of nature at that time, and the time-ordering relation is simply the relation between such states, then the irrevocableness of time would seem to mean that an actual state of all nature can never return. I admit it seems unlikely that there should ever be such a recurrence down to the smallest particular. But extreme unlikeliness is not the point. Our ignorance is so abysmal that our judgments of likeliness and unlikeliness of future events hardly count. The real point is that the exact recurrence of a state of nature seems merely unlikely, while the recurrence of an instant of time violates our whole concept of time-order. The instants of time which have passed, are passed, and can never be again.

Any alternative theory of time must reckon with these two considerations which are buttresses of the absolute theory. But I will not now continue their discussion.

The absolute theory of space is analogous to the corresponding theory of time, but the reasons for its maintenance are weaker. Space, on this theory, is a system of extensionless points which are the relata in space-ordering relations which can technically be combined into one relation. This relation does not arrange the points in one linear series analogously to the simple method of the time-ordering relation for instants. The essential logical characteristics of this relation from which all the properties of space spring are expressed by mathematicians in the axioms of geometry. From these axioms as framed by modern mathematicians the whole science of geometry can be deduced by the strictest logical reasoning. The details of these axioms do not now concern us. The points and the relations are jointly known to us in our apprehension of space, each implying the other. What happens in space, occupies space. This relation of occupation is not usually stated for events but for objects. For example, Pompey's statue would be said to occupy space, but not the event which was the assassination of Julius Caesar. In this I think that ordinary usage is unfortunate, and I hold that the relations of events to space and to time are in all respects analogous. But here I am intruding my own opinions which are to be discussed in subsequent lectures. Thus the theory of absolute space requires that we are aware of two fundamental relations, the space-ordering relation, which holds between points, and the space-occupation relation between points of space and material objects.

This theory lacks the two main supports of the corresponding theory of absolute time. In the

first place space does not extend beyond nature in the sense that time seems to do. Our thoughts do not seem to occupy space in quite the same intimate way in which they occupy time. For example, I have been thinking in a room, and to that extent my thoughts are in space. But it seems nonsense to ask how much volume of the room they occupied, whether it was a cubic foot or a cubic inch; whereas the same thoughts occupy a determinate duration of time, say, from eleven to twelve on a certain date.

Thus whereas the relations of a relative theory of time are required to relate thoughts, it does not seem so obvious that the relations of a relative theory of space are required to relate them. The connexion of thought with space seems to have a certain character of indirectness which appears to be lacking in the connexion of thought with time.

Again the irrevocableness of time does not seem to have any parallel for space. Space, on the relative theory, is the outcome of certain relations between objects commonly said to be in space; and whenever there are the objects, so related, there is the space. No difficulty seems to arise like that of the inconvenient instants of time which might conceivably turn up again when we thought that we had done with them.

The absolute theory of space is not now generally popular. The knowledge of bare space, as a system of entities known to us in itself and for itself independently of our knowledge of the events in nature, does not seem to correspond to anything in our experience. Space, like time, would appear to be an abstraction from events. According to my own theory it only differentiates itself from time at a somewhat developed stage of the abstractive process. The more usual way of expressing the relational theory of space would be to consider space as an abstraction from the relations between material objects.

Suppose now we assume absolute time and absolute space. What bearing has this assumption on the concept of nature as bifurcated into causal nature and apparent nature? Undoubtedly the separation between the two natures is now greatly mitigated. We can provide them with two systems of relations in common; for both natures can be presumed to occupy the same space and the same time. The theory now is this: Causal events occupy certain periods of the absolute time and occupy certain positions of the absolute space. These events influence a mind which thereupon perceives certain apparent events which occupy certain periods in the absolute time and occupy certain positions of the absolute space; and the periods and positions occupied by the apparent events bear a determinate relation to the periods and positions occupied by the causal events.

Furthermore definite causal events produce for the mind definite apparent events. Delusions are apparent events which appear in temporal periods and spatial positions without the intervention of these causal events which are proper for influencing of the mind to their perception.

The whole theory is perfectly logical. In these discussions we cannot hope to drive an unsound theory to a logical contradiction. A reasoner, apart from mere slips, only involves himself in a contradiction when he is shying at a *reductio ad absurdum*. The substantial reason

for rejecting a philosophical theory is the ‘absurdum’ to which it reduces us. In the case of the philosophy of natural science the ‘absurdum’ can only be that our perceptual knowledge has not the character assigned to it by the theory. If our opponent affirms that his knowledge has that character, we can only—after making doubly sure that we understand each other—agree to differ. Accordingly the first duty of an expositor in stating a theory in which he disbelieves is to exhibit it as logical. It is not there where his trouble lies.

Let me summarise the previously stated objections to this theory of nature. In the first place it seeks for the cause of the knowledge of the thing known instead of seeking for the character of the thing known: secondly it assumes a knowledge of time in itself apart from events related in time: thirdly it assumes a knowledge of space in itself apart from events related in space. There are in addition to these objections other flaws in the theory.

Some light is thrown on the artificial status of causal nature in this theory by asking, why causal nature is presumed to occupy time and space. This really raises the fundamental question as to what characteristics causal nature should have in common with apparent nature. Why—on this theory—should the cause which influences the mind to perception have any characteristics in common with the effluent apparent nature? In particular, why should it be in space? Why should it be in time? And more generally, What do we know about mind which would allow us to infer any particular characteristics of a cause which should influence mind to particular effects?

The transcendence of time beyond nature gives some slight reason for presuming that causal nature should occupy time. For if the mind occupies periods of time, there would seem to be some vague reason for assuming that influencing causes occupy the same periods of time, or at least, occupy periods which are strictly related to the mental periods. But if the mind does not occupy volumes of space, there seems to be no reason why causal nature should occupy any volumes of space. Thus space would seem to be merely apparent in the same sense as apparent nature is merely apparent. Accordingly if science is really investigating causes which operate on the mind, it would seem to be entirely on the wrong tack in presuming that the causes which it is seeking for have spatial relations. Furthermore there is nothing else in our knowledge analogous to these causes which influence the mind to perception. Accordingly, beyond the rashly presumed fact that they occupy time, there is really no ground by which we can determine any point of their character. They must remain for ever unknown.

Now I assume as an axiom that science is not a fairy tale. It is not engaged in decking out unknowable entities with arbitrary and fantastic properties. What then is it that science is doing, granting that it is effecting something of importance? My answer is that it is determining the character of things known, namely the character of apparent nature. But we may drop the term ‘apparent’; for there is but one nature, namely the nature which is before us in perceptual knowledge. The characters which science discerns in nature are subtle characters, not obvious at first sight. They are relations of relations and characters of characters. But for all their subtlety they are stamped with a certain simplicity which makes their consideration essential in

unravelling the complex relations between characters of more perceptive insistence.

The fact that the bifurcation of nature into causal and apparent components does not express what we mean by our knowledge is brought before us when we realise our thoughts in any discussion of the causes of our perceptions. For example, the fire is burning and we see a red coal. This is explained in science by radiant energy from the coal entering our eyes. But in seeking for such an explanation we are not asking what are the sort of occurrences which are fitted to cause a mind to see red. The chain of causation is entirely different. The mind is cut out altogether. The real question is, When red is found in nature, what else is found there also? Namely we are asking for an analysis of the accompaniments in nature of the discovery of red in nature. In a subsequent lecture I shall expand this line of thought. I simply draw attention to it here in order to point out that the wave-theory of light has not been adopted because waves are just the sort of things which ought to make a mind perceive colours. This is no part of the evidence which has ever been adduced for the wave-theory, yet on the causal theory of perception, it is really the only relevant part. In other words, science is not discussing the causes of knowledge, but the coherence of knowledge. The understanding which is sought by science is an understanding of relations within nature.

So far I have discussed the bifurcation of nature in connexion with the theories of absolute time and of absolute space. My reason has been that the introduction of the relational theories only weakens the case for bifurcation, and I wished to discuss this case on its strongest grounds.

For instance, suppose we adopt the relational theory of space. Then the space in which apparent nature is set is the expression of certain relations between the apparent objects. It is a set of apparent relations between apparent relata. Apparent nature is the dream, and the apparent relations of space are dream relations, and the space is the dream space. Similarly the space in which causal nature is set is the expression of certain relations between the causal objects. It is the expression of certain facts about the causal activity which is going on behind the scenes. Accordingly causal space belongs to a different order of reality to apparent space. Hence there is no pointwise connexion between the two and it is meaningless to say that the molecules of the grass are in any place which has a determinate spatial relation to the place occupied by the grass which we see. This conclusion is very paradoxical and makes nonsense of all scientific phraseology. The case is even worse if we admit the relativity of time. For the same arguments apply, and break up time into the dream time and causal time which belong to different orders of reality.

I have however been discussing an extreme form of the bifurcation theory. It is, as I think, the most defensible form. But its very definiteness makes it the more evidently obnoxious to criticism. The intermediate form allows that the nature we are discussing is always the nature directly known, and so far it rejects the bifurcation theory. But it holds that there are psychic additions to nature as thus known, and that these additions are in no proper sense part of nature. For example, we perceive the red billiard ball at its proper time, in its proper place, with its proper motion, with its proper hardness, and with its proper inertia. But its redness and its

warmth, and the sound of the click as a cannon is made off it are psychic additions, namely, secondary qualities which are only the mind's way of perceiving nature. This is not only the vaguely prevalent theory, but is, I believe, the historical form of the bifurcation theory in so far as it is derived from philosophy. I shall call it the theory of psychic additions.

This theory of psychic additions is a sound common-sense theory which lays immense stress on the obvious reality of time, space, solidity and inertia, but distrusts the minor artistic additions of colour, warmth and sound.

The theory is the outcome of common-sense in retreat. It arose in an epoch when the transmission theories of science were being elaborated. For example, colour is the result of a transmission from the material object to the perceiver's eye; and what is thus transmitted is not colour. Thus colour is not part of the reality of the material object. Similarly for the same reason sounds evaporate from nature. Also warmth is due to the transfer of something which is not temperature. Thus we are left with spatio-temporal positions, and what I may term the 'pushiness' of the body. This lands us to eighteenth and nineteenth century materialism, namely, the belief that what is real in nature is matter, in time and in space and with inertia.

Evidently a distinction in quality has been presupposed separating off some perceptions due to touch from other perceptions. These touch-perceptions are perceptions of the real inertia, whereas the other perceptions are psychic additions which must be explained on the causal theory. This distinction is the product of an epoch in which physical science has got ahead of medical pathology and of physiology. Perceptions of push are just as much the outcome of transmission as are perceptions of colour. When colour is perceived the nerves of the body are excited in one way and transmit their message towards the brain, and when push is perceived other nerves of the body are excited in another way and transmit their message towards the brain. The message of the one set is not the conveyance of colour, and the message of the other set is not the conveyance of push. But in one case colour is perceived and in the other case the push due to the object. If you snip certain nerves, there is an end to the perception of colour; and if you snip certain other nerves, there is an end to the perception of push. It would appear therefore that any reasons which should remove colour from the reality of nature should also operate to remove inertia.

Thus the attempted bifurcation of apparent nature into two parts of which one part is both causal for its own appearance and for the appearance of the other part, which is purely apparent, fails owing to the failure to establish any fundamental distinction between our ways of knowing about the two parts of nature as thus partitioned. I am not denying that the feeling of muscular effort historically led to the formulation of the concept of force. But this historical fact does not warrant us in assigning a superior reality in nature to material inertia over colour or sound. So far as reality is concerned all our sense-perceptions are in the same boat, and must be treated on the same principle. The evenness of treatment is exactly what this compromise theory fails to achieve.

The bifurcation theory however dies hard. The reason is that there really is a difficulty to be

faced in relating within the same system of entities the redness of the fire with the agitation of the molecules. In another lecture I will give my own explanation of the origin of the difficulty and of its solution.

Another favourite solution, the most attenuated form which the bifurcation theory assumes, is to maintain that the molecules and ether of science are purely conceptual. Thus there is but one nature, namely apparent nature, and atoms and ether are merely names for logical terms in conceptual formulae of calculation.

But what is a formula of calculation? It is presumably a statement that something or other is true for natural occurrences. Take the simplest of all formulae, Two and two make four. This—so far as it applies to nature—asserts that if you take two natural entities, and then again two other natural entities, the combined class contains four natural entities. Such formulae which are true for any entities cannot result in the production of the concepts of atoms. Then again there are formulae which assert that there are entities in nature with such and such special properties, say, for example, with the properties of the atoms of hydrogen. Now if there are no such entities, I fail to see how any statements about them can apply to nature. For example, the assertion that there is green cheese in the moon cannot be a premiss in any deduction of scientific importance, unless indeed the presence of green cheese in the moon has been verified by experiment. The current answer to these objections is that, though atoms are merely conceptual, yet they are an interesting and picturesque way of saying something else which is true of nature. But surely if it is something else that you mean, for heaven's sake say it. Do away with this elaborate machinery of a conceptual nature which consists of assertions about things which don't exist in order to convey truths about things which do exist. I am maintaining the obvious position that scientific laws, if they are true, are statements about entities which we obtain knowledge of as being in nature; and that, if the entities to which the statements refer are not to be found in nature, the statements about them have no relevance to any purely natural occurrence. Thus the molecules and electrons of scientific theory are, so far as science has correctly formulated its laws, each of them factors to be found in nature. The electrons are only hypothetical in so far as we are not quite certain that the electron theory is true. But their hypothetical character does not arise from the essential nature of the theory in itself after its truth has been granted.

Thus at the end of this somewhat complex discussion, we return to the position which was affirmed at its beginning. The primary task of a philosophy of natural science is to elucidate the concept of nature, considered as one complex fact for knowledge, to exhibit the fundamental entities and the fundamental relations between entities in terms of which all laws of nature have to be stated, and to secure that the entities and relations thus exhibited are adequate for the expression of all the relations between entities which occur in nature.

The third requisite, namely that of adequacy, is the one over which all the difficulty occurs. The ultimate data of science are commonly assumed to be time, space, material, qualities of material, and relations between material objects. But data as they occur in the scientific laws do not relate all the entities which present themselves in our perception of nature. For example,



the wave-theory of light is an excellent well-established theory; but unfortunately it leaves out colour as perceived. Thus the perceived redness—or, other colour—has to be cut out of nature and made into the reaction of the mind under the impulse of the actual events of nature. In other words this concept of the fundamental relations within nature is inadequate. Thus we have to bend our energies to the enunciation of adequate concepts.

But in so doing, are we not in fact endeavouring to solve a metaphysical problem? I do not think so. We are merely endeavouring to exhibit the type of relations which hold between the entities which we in fact perceive as in nature. We are not called on to make any pronouncement as to the psychological relation of subjects to objects or as to the status of either in the realm of reality. It is true that the issue of our endeavour may provide material which is relevant evidence for a discussion on that question. It can hardly fail to do so. But it is only evidence, and is not itself the metaphysical discussion. In order to make clear the character of this further discussion which is out of our ken, I will set before you two quotations. One is from Schelling and I extract the quotation from the work of the Russian philosopher Lossky which has recently been so excellently translated into English—‘In the “Philosophy of Nature” I considered the subject-object called nature in its activity of self-constructing. In order to understand it, we must rise to an intellectual intuition of nature. The empiricist does not rise thereto, and for this reason in all his explanations it is always *he himself* that proves to be constructing nature. It is no wonder, then, that his construction and that which was to be constructed so seldom coincide. A *Natur-philosoph* raises nature to independence, and makes it construct itself, and he never feels, therefore, the necessity of opposing nature as constructed (*i.e.* as experience) to real nature, or of correcting the one by means of the other.’

The other quotation is from a paper read by the Dean of St Paul’s before the Aristotelian Society in May of 1919. Dr Inge’s paper is entitled ‘Platonism and Human Immortality,’ and in it there occurs the following statement: ‘To sum up. The Platonic doctrine of immortality rests on the *independence* of the spiritual world. The spiritual world is not a world of unrealised ideals, over against a real world of unspiritual fact. It is, on the contrary, the real world, of which we have a true though very incomplete knowledge, over against a world of common experience which, as a complete whole, is not real, since it is compacted out of miscellaneous data, not all on the same level, by the help of the imagination. There is no world corresponding to the world of our common experience. Nature makes abstractions for us, deciding what range of vibrations we are to see and hear, what things we are to notice and remember.’

I have cited these statements because both of them deal with topics which, though they lie outside the range of our discussion, are always being confused with it. The reason is that they lie proximate to our field of thought, and are topics which are of burning interest to the metaphysically minded. It is difficult for a philosopher to realise that anyone really is confining his discussion within the limits that I have set before you. The boundary is set up just where he is beginning to get excited. But I submit to you that among the necessary prolegomena for philosophy and for natural science is a thorough understanding of the types of entities, and

types of relations among those entities, which are disclosed to us in our perceptions of nature.

---

Alfred North Whitehead. *The Concept of Nature: Tarner Lectures Delivered in Trinity College, November 1919*. Cambridge: University Press, 1920.

© SophiaOmni, 2005. The specific electronic form of this text is copyright. Permission is granted to print out copies for educational purposes and for personal use only. No permission is granted for commercial use.