IV.6 · Parmenides and Quantum Theory

Written in 1970 and unpublished until now. According to Platonic doctrine, the "Ideas of things" discussed in the preceding essay must refer back to the higher Ideas and, in the end, to the One. The prelude, which deals with a critique of the Ideas, is therefore followed by a fugue that criticizes the opinions concerning the One. In modern science, the organic forms refer back to the universal laws of nature; i.e., in the end to the unity of nature. We encounter this unity in quantum theory. The confrontation of the first hypothesis in the Parmenides Dialogue with quantum theory is therefore the natural next step. This confrontation is the subject of sections d and e of this essay, the first three sections being introductory in nature. It turns out that a relationship exists between Bohr's complementarity and Plato's dialectic.

a) What Does the Unity of Nature Mean?

We begin by recapitulating the facts and conjectures in which the idea of the unity of nature has presented itself.[1]

The *unity of the law* comes first. This is merely another expression for what physicists call the *universal validity of a fundamental theory*. A "theory" of this type consists of a number of terms, as well as of fundamental propositions which connect these terms and from which additional propositions can logically be deduced. Further, it must be sufficiently clear for practical purposes how the theoretical terms are to be applied in experience, and thus also how the theoretical propositions can be put to the test. A theory has "validity" only if these procedures are available, and if the propositions thus tested agree with experience. We will not recapitulate the methodological problems implicit in these requirements but will rely for the moment on the fact that, in general, physicists agree on these matters among themselves. The validity is "universal" if it extends to all possible objects of a theory; i.e., to all objects covered by the terms of the theory. Here, too, we are satisfied for the moment with practical universality, leaving open the discovery of exceptions or of still more universal laws. We will call a theory "fundamental" if it extends to all possible objects of nature. The universal validity of a fundamental theory means that all

[1] Cf. II.1d*ii* and II.5b.

objects of nature are subject to one and the same lawful scheme; it is in this sense that we term this validity the "unity of the law." Let me emphasize that all these terms are merely descriptive. They formulate the approximate self-interpretation of contemporary physics, and the following recapitulating reflections will clarify or revise them.

We do have such a fundamental theory—namely, quantum theory. Let us examine in more detail what demands should be imposed on a fundamental theory, and in what sense quantum theory fulfills them.

The theory is to apply to arbitrary objects of nature. To this end, it must be capable of characterizing an arbitrary object. It does so by specifying the totality of its possible ("formally possible") *states*. The theory must also specify how these states can *change* in time. These two requirements can be stated from the point of view of classical physics; quantum theory supplements the requirements in its own characteristic way—namely, by fulfilling them.

According to quantum theory, every object possesses, mathematically speaking, the *same* manifold of possible states;[2] these can be characterized as the one-dimensional subspaces of a Hilbert space. Quantum theory also specifies a universal rule for the *composition* of two objects into a single object: the Hilbert space of the composite object is the Kronecker product of the Hilbert spaces of the two part-objects. The theory subdivides the question as to the temporal change of the states into two questions. If the state changes without being observed, it does so in accordance with a *unitary transformation* of Hilbert space. A particular *species of objects* (e.g., helium atoms) is characterized by its formally possible unitary transformations, which are mathematically specified by their infinitesimal element, the *Hamilton operator H*. The Hamilton operator of an isolated object characterizes its internal dynamics and thereby designates certain of its states (for example) as eigenstates of H with particular eigenvalues of the energy. The interaction of the object with other objects is described in terms of the Hamilton operator of the composite object constituted by these objects; this operator can, within certain approximations, be reduced to the Hamilton operator of the original object taken as situated alone in a fixed environment. If, on the other hand, the state is *observed*, then the state changes in another manner. A particular observation admits of only a subset of the formally possible states of the object as possible results of measurement; this subset is constituted by the eigenstates of the Hamilton operator of the object

[2]We will not refer to the Postulate of Finitism (II.5d*iv*) in the present description of existing quantum theory. The theory sketched in II.5e will also not be considered.

when the instrument of measurement is specified as part of its environment. If ψ was the state prior to the observation, then the probability of finding a particular state φ_n among the manifold of possible results of the observation equals the square of the magnitude of the inner product of the unit vectors in the directions of states ψ and φ_n.

Because of the mathematical formalism that it requires, this description of quantum theory might seem a bit heavy-handed. From the conceptual point of view, the theory may be said to achieve a certain maximum in possible simplicity. The theory characterizes, in unique terms and by means of universally valid prescriptions, arbitrary objects, their composition, changes in their state when not observed, and the prediction of observations. And yet quantum theory, even if we assume it to be universally valid, does not yet express the full unity of nature.

For one can speak, secondly, of a unity of nature in the sense of a *unitary character of the species of objects*. This character expresses itself in quantum theory in the existence of objects with particular Hamilton operators. Today we believe that all species of objects can in principle be explained as being composed of a small number of species of elementary particles. In the case of inorganic nature, we all believe this to be so; in the case of living organisms, it is the hypothesis on which we have based this book. Finally, we hope to reduce the species of elementary particles to a single basic lawful order, which perhaps we ought not to describe as the existence of a single basic species but rather as the law that specifies all of them.

Thirdly, in the context of contemporary cosmology, it makes sense to talk of the unity of nature as the *totality of objects*. One speaks of *the world* as if it were a single object. Quantum theory does indeed permit the composition of arbitrary objects into a new object. It even requires this composition, in the sense that it regards the actual state space of a number of coexisting objects as precisely the state space of the total object they compose; the isolation of individual objects is, in the eyes of quantum theory, always a mere approximation. If the totality of objects in the world can, at least in principle, be enumerated, then quantum theory obliges us in principle to introduce the additional object "world," which is composed of that totality. At this point, however, certain conceptual problems that form a principal theme of the present essay appear. Let me merely name them for now: If the object "world" is to exist, for whom is it an object? How are we to conceive of an observation of this object? If, on the other

hand, the object "world" is inadmissible, how are we to describe the coexistence of objects "in the world" quantum mechanically? Or are we to conclude that quantum theory meets its limits here?

Fourthly, we have tried to base the unity of nature (as conceived under the three preceding aspects) on the *unity of experience.* We talked, to begin with, of the preconditions of the possibility of experience, and understood "experience" to already be unified in the sense that "every" experience may be thought of as connected with every other experience in a contexture of interactions that is free from internal contradictions. This unity appears in Kant under the title of "the unity of apperception." In our own approach, which starts not from subjectivity but from temporality, this unity appears as the *unity of time.* The unity of time (which in our presentation of course embraces space) is, most likely, the only adequate framework for the problem of the totality of objects. With these latter reflections we have delved into the midst of the fundamental problems of classical philosophy. Before confronting these problems, we must still introduce our last approach, the approach of cybernetics.

Fifthly, the *unity of man and nature* is part of our conception of the unity of nature. Man, in whose experience the unity of nature is discovered, is at the same time part of nature. We try to describe human experience in terms of a cybernetics of truth, which is conceived of as a process in nature. The philosophical problem that arises here is obvious: if this program can be carried through, at least in principle, then the unity of nature is somehow represented within nature as the unity of the experience of man. What does this "somehow" mean? To put it differently: the subjects, for whom the objects are objects, now form part of the totality of objects. Furthermore, in a cybernetics of truth, human consciousness stands apart from animal subjectivity as a higher-level structure, but the two are also part of a genetic continuum. In the attempt to reduce matter and energy to information, the subjectivity of all substance, if only implicitly and unclearly, is presupposed.[3] The classical formula that nature is spirit which does not know itself as spirit urges itself upon us as a shorthand notation for these problems; but this does not mean that we have understood this formula in the least.

As a next step, we therefore explicitly confront our complex of problems with the ideas of classical philosophy, among which we in fact already find ourselves. Aren't we in the midst of the problems

[3]Cf. III.3 and III.5f.

faced by the Eleatic philosopher Parmenides? *Hen to pan:* One is the totality. The totality is, first of all, the world, "comparable to a well-rounded sphere." But this world embraces experiencing as much as what is experienced, consciousness as well as Being: *To gar auto noein estin te kai einai,* for it is the same to see and to be. I translated *noein* with "to see" to avoid the abstract introversion of "to think." What can Parmenides teach us?

b) A Digression: How Can One Read the Philosophers?

Anyone who turns to the contemporary secondary literature for information on the Eleatic philosopher Parmenides, or on Plato's *Parmenides* Dialogue, can only fall into despair.

How primitive was Parmenides? Was he an astronomical materialist who believed in a spherically shaped universe? Did he suppose—as determined materialists who came after him did—that matter can also think? Was he a pantheist, to whom thinking matter appeared to be God? Was he a spiritualist, for whom the spatial world of appearances was a mere delusion? Is his philosophy the result of his not yet having grasped the difference between consciousness and matter, or between form and matter? Or does the *esti* with the infinitive mean "one can," so that he would simply be teaching us that reality can be known: "one can think that which can be"? Does he assert that all movement is mere appearance? If so, does he fail to notice that this teaching of his is itself a movement? Is he the victim of a still immature logic? Does he confuse logic and ontology? Is it his reward that he began the search for a rigorous logic? Or was it, rather, that he discovered substance, as the permanent element amidst change? He seems, in any case, to have been a forerunner; but whose forerunner?

And as to Plato's *Parmenides:* does the "prelude" relinquish the theory of Ideas, or is it a self-criticism on the road to an improved theory of Ideas, or a preparation for the theory of Ideas? And concerning the first hypothesis of the "fugue": is it meant "merely negatively," or merely "positively," or both? Is it merely a refutation of the Eleatic philosopher Parmenides, which Plato most generously has Parmenides himself deliver? Does it deal with any Idea whatever, insofar as it is an Idea? Does it deal with Plato's One, or with the One of the Neoplatonists? Do these alternatives amount to the same, or are they utterly different? Is the *Parmenides* a logical exercise, a bit of horseplay, or is it Western theology on its highest level?