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CHAPTER EIGHT

REALITY IN HEISENBERG'S PHILOSOPHY

SECTION I: THE EARLY HEISENBERG

General Outline

Heisenberg's discovery of quantum mechanics was accompanied, as we have seen, by a great insight which was of the nature of a profound metaphysical conversion; it was the discovery of a new meaning for *reality* which was different from that of Newton, Gauss, Maxwell, Hertz and the grand tradition of classical physics. The sudden swing to the crude empiricism which characterised the early days of complementarity did not last in Heisenberg's case, but changed slowly under the subtle polarising influence of a strong rationalist tendency which was in keeping with his temperament and choice and was encouraged by his mathematical powers. Just as Einstein began his philosophic career under the influence of Hume and Mach to end fifty years later in spiritual companionship with Leibniz and Spinoza, so Heisenberg began as a disciple of Hume and ended in the company of Kant. The transition was not sudden like his first conversion, nor was he conscious of the growing complexity of his thought. If he had been, he would have taken greater pains in his later writings to distinguish his early views from his later. The only indication of the metamorphosis that occurred between 1925 and 1955 is in the change in usage of such words as "objectivity", "causality", "reality", etc., which a careful examination of the context reveals. We have described this metamorphosis elsewhere as the conquering of Hume by Kant; we might also summarise his philosophical development as the result of a dialectic between the Plato of his temperament and choice, and the empiricism forced upon him by the discovery of quantum mechanics and by the environment of Copenhagen.

Heisenberg's Empiricism

In his early papers and lectures on quantum mechanics, Heisenberg insisted that physical quantities were real only when they were actually observed, i.e., when they were instances describable in Euclidean space at a definite time and given in perception [1]. Whatever "lacked intuitive foundation" [2], whatever had no "observational consequences" [3], whatever is "not experimentally verified" [4] is simply excluded from the realm of physical reality.

The new emphasis on human sensibility might, however, be construed in two different ways: either as constitutive of a new meaning (sense or connotation) for the term *reality* or as contributing merely to a new criterion of the real in human knowing without connoting a corresponding change in sense [5]. The distinction is an important one from the point of view of philosophy; for the basic metaphysical orientation of a philosopher's mind is specified by the sense he assigns to the term "reality". In everyday life, we do not generally distinguish between meaning (or intrinsic connotation) and criteria (which, generally, are extrinsic associations); for it is ordinarily sufficient that in daily life our words are correctly applied and correctly understood, and for this purpose the present distinction is not required. It is a distinction however which, even if acknowledged, is rarely given the epistemological importance it merits. Nagel, for example, and other philosophers of science of a positivistic bias seem to think it is just a question of "terminological interest" and "preferred modes of speech"[6]. Its importance is in the classification of ontological views, for it is only with the help of this distinction that a particular opinion can be situated with accuracy within the traditional extremes of rationalism and empiricism.

As Heisenberg was not consciously aware of this distinction his attitude has to be judged by inference from his statements. In his early writings, the real object of physics tended to be identified with observed events described in everyday or classical physical concepts.

[1] "Modern physics is concerned not with the essence and structure of the atom but with observable events and thus places emphasis on the measurement process" wrote Heisenberg in "Kausalgesetz und Quantum Mechanik", *Erkenntnis*, II (1931), pp. 182–183. He goes on to say that it is not the *Beobachtungsobjekt allein* with which physics deals but the *Beobachtungsvorgänge*. Cf. also *Niels Bohr* etc., p. 22.

[2] Heisenberg, *Zeit. f. Physik*, XXXIII (1925), 879; XLIII (1927), 172.

[3] Heisenberg, *Physical Principles* etc., p. 15.

[4] *Ibid.*, p. 1.

[5] *Supra*, chap. I, sect. I; chap. V, sect. I, e.g., p. 85.

[6] E. Nagel's *Structure of Science* (London: 1961), chap. VI.

Since in the realm of quantum mechanics these do not obey causal laws, the real objects of physics cannot be conceptually or rationally expressed – at least not if the quantum system is conceived to move continuously like a body. Conceptual schemes like the concept "atom", he wrote, merely make possible a simple formulation of the laws governing all physical and chemical processes [1]. All this implied a rejection of the classical rationalist thesis. Moreover, in his description of the subject-object relation in which the criterion of the real is found, the type of opposition he describes is clearly conceived to be one of spatial exteriority [2]. Thus, one aspect of Heisenberg's philosophical conversion is correctly described as the discovery of a new and essentially empiricist (or phenomenalist) meaning for *reality*.

Influence of Plato

Heisenberg, however, was not happy in this condition; for both by temperament and by training he inclined to speculative, abstract and formal theories. Even in his early writings, one can find the implicit distinction between two classes of "real objects": the "empirically real" and the "rationally real", which were not, however, distinguished consciously and consciously compared [3]. If empirical reality lacked the properties of formal symmetry, invariance and necessity, then there must be another kind of reality which was the bearer of these; for Heisenberg was deeply imbued with the conviction that rationality (or at least legality) was a universal law, and for him its absence was an unendurable intellectual scandal. In this respect, he was the antithesis of Bohr who, after "muddling through" brilliantly, was ready to conclude that reality is, after all, a "muddle".

If Bohr represented the influence of Protagoras, Heisenberg came early under the spell of Plato. He tells that when he was eighteen years old the abortive communist revolution of 1919 took place in Bavaria. He was temporarily drafted into the army and sent to guard the Theological Seminary in Munich [4]. There he talked philosophy with the students and spent the early morning hours after sunrise on the roof of the seminary reading the *Timaeus* of Plato [5]. He was much impressed by the notion that behind this illusory world of sense, there

[1] Heisenberg, *Philosophic Problems* etc., p. 56.
[2] Heisenberg, *Physical Principles* etc., pp. 58, 64. Also cf. *supra*, pp. 86f.
[3] Cf. Heisenberg, *Philosophic Problems* etc., pp. 20–26, 106–107.
[4] Heisenberg, *Physicist's Conception of Nature*, pp. 53–58.
[5] *Ibid.*, pp. 53–58; *Philosophic Problems* etc., 35, 98; also cf. "Planck's Discovery and the Problems of Modern Physics" by W. Heisenberg in *On Modern Physics* (London: Orion Press, 1961), p. 19.

was a real world of elementary particles which were pure mathematical forms.

The influence of Plato was to lead him to a conviction which he retained throughout even his empiricist days that there were two kinds of realities: intelligible realities which were the objects of *episteme* or intellectual intuition, and sensible objects which were objects of sensible intuition. He believed that we lacked the former kind of knowledge. The combination of abstractive understanding and empirical intuition to which we were reduced in consequence obtained for us merely token or symbolic knowledge of physical reality but not true knowledge. The type of symbolic knowledge characteristic of physical science he called *dianoia*. These early views led him naturally in the direction of Kant [1].

SECTION II: HEISENBERG AND KANT

The Crisis of Kantian Critique

The second great influence on Heisenberg's thought was Kant, and it was within the Kantian problematic that Heisenberg eventually came to find his spiritual home. We have noted how his lively interest in Plato prepared his mind. Kant's transcendental method of philosophy, moreover, makes an unfailing appeal to a theoretical physicist, for its starting point, viz., the acceptance of universal and necessary scientific laws is one towards which he is sympathetically disposed. Because of this peculiar dependence of Kantian philosophy on classical physics, the first serious impact of modern physics on the world of philosophy was its effect on the transcendental critique. Relativity overthrew the absoluteness of Euclidean geometry and quantum mechanics showed that causality in science (in the sense of antecedent-consequent legality between phenomena) was not universal or necessary [2]. If the Kantian starting point is mistaken, if science presupposes no universal or necessary principles then there is no problematic, and the philosophy built upon it – however sublime – is no more than a piece of groundless fancy. This collapse of the most

[1] Heisenberg, *Philosophic Problems* etc., pp. 32–34. The distinction between the two classes of objects and their relation to Kant was already expressed in a lecture given in 1934. He adds: "There has not yet been a discussion based upon the new outlook that is sufficiently thorough to show how far this idea [of the *a priori*] is still fruitful in the wider philosophical fields which were essential for Kant", *Philosophic Problems* etc., p. 21.

[2] *Ibid.*, p. 20; *Erkenntnis*, II (1931), pp. 182–183; *On Modern Physics*, p. 12.

prestigious of classical metaphysical schemes was certainly one of the major contributing causes of the practical hegemony of positivism in scientific circles during the years following the discovery of relativity and quantum mechanics.

The most disturbing failure of Kantian epistemology in modern physics was the failure of causality in quantum mechanics: for without causality there is no stable phenomenal object of experience. Another category, *substance*, consequently fails on the quantum level [1]. For causality can be applied only where there is continuity and coherence in the field of experience, where phenomena are grouped into localised wholes which preserve their self-identity in time and move along continuous trajectories in three-dimensional Euclidean space. Causality is then a necessary condition for the application of the category of substance in human experience. "Nature, through the medium of modern physics", wrote Heisenberg, "has reminded us very clearly that we should never hope for such a firm basis [as Cartesian rationalism] for the comprehension of the whole field of 'things perceptible'" [2]. The failure of causality in quantum mechanics meant the breakdown of the attempt to view nature as a systematic totality of related bodies: nature must henceforth be described in terms of individual observation events, i.e., instantaneously localised occurrences – atomic reality-elements, as it were – for which we fashion artificial links through which they are connected "in an abstract space" [3].

Substance, in Kantian epistemology, or the permanent filling of the category of reality, symbolised the presence of noumenal reality, which itself remained, however, shrouded in mystery. The failure of the category of *substance* in quantum mechanics broke the link between the quantum mechanical object and noumenal reality. If a quantum mechanical system is not a stable phenomenal object, i.e., not a "substance", then neither in the Kantian view does it symbolise a noumenal reality.

These thoughts were scarcely more than implicit in Heisenberg's mind for a long time after the discovery of quantum mechanics. During this period he was dominated uneasily by an idealistic (or positivistic) empiricism more in the tradition of Berkeley and Mach than in that of Hume or Locke.

[1] *Erkenntnis, loc. cit.*, pp. 172–182; *Physical Principles* etc., pp. 2, 63. Cf. I. Kant, *Critique of Pure Reason*, trans. by N. Kemp Smith, p. 212 for "substance" and p. 218 for "causality".

[2] *Philosophic Problems* etc., p. 25.

[3] *Ibid.*, p. 93.