Essay Review
Wigner's View of Physical Reality

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Jagdish Mehra (ed.): *The Collected Works of Eugene Paul Wigner. Part B. Historical, Philosophical, and Socio-Political Papers. Volume 6: Philosophical Reflections and Syntheses* (annotated by Gérard G. Emch) (Berlin: Springer, 1995), XX + 631 pp., ISBN 3-540-56986-3.

1. Introduction

Nearly all the papers which the eminent physicist Eugene P. Wigner (1902–1995) published as well as hitherto unpublished manuscripts are reprinted in the Collected Works in eight volumes. The material is divided into part A (edited by Arthur Wightman), covering the scientific papers, and part B (edited by Jagdish Mehra), containing the philosophical, historical, and socio-political papers. The five volumes of part A are already published. From the three volumes of part B, only volume 6, entitled *Philosophical Reflections and Syntheses*, is published as yet. Volume 7, *Historical and Biographical Reflections and Syntheses* and volume 8, *Socio-Political Reflections and Civil Defence* are in preparation.

This edition makes Wigner's work easily accessible. It thereby fulfills a *desideratum* for the history and philosophy of physics. This edition will hopefully contribute to Wigner's work receiving the attention it deserves in the history and philosophy of physics. Volume 6 contains a helpful introduction by Gérard Emch, and it is beautifully produced. Unfortunately, in the reprinted lecture [146] 'Interpretation of Quantum Mechanics' (pp. 78–132)[2], the references are missing. More importantly, the collaboration between the editors of parts A and B is unsatisfactory. The division of the papers on measurement in quantum mechanics between volume 3 and volume 6 is inappropriate. Six papers on that topic are even reprinted in both volumes.

Volume 6 contains papers on the epistemology of quantum mechanics, the quantum-mechanical measuring process, consciousness, symmetries, relativity, and nuclear physics as well as broader philosophical essays. By no means can this essay review cover all these topics. I focus on Wigner's conception of physical reality in connection with the measurement problem in quantum mechanics. I first present Wigner's views on these topics as they are stated in the papers collected in volume 6 and then evaluate these views in the light of contemporary developments.

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2 All numbers in brackets indicate the page numbers in Vol. 6.

2. Wigner on Physical Reality and Quantum Mechanics

2.1 The content of consciousness as the primary reality

The best starting point for a presentation of Wigner's account of physical reality is his paper 'Two Kinds of Reality' (pp. 33–47). This paper was originally published in the philosophical journal *The Monist* in 1964. The theses which Wigner sets out in this essay occur frequently throughout all his philosophical papers. By two kinds of reality, he means the content of the consciousness of each person on the one hand and physical objects on the other hand. Sense impressions in particular are the content of consciousness on which he focuses. Wigner claims that the content of consciousness is the primary reality: it is absolute. Its reality cannot consistently be denied. The reality of physical objects, by contrast, is relative to the content of consciousness. According to Wigner, physical objects are constructed on the basis of the content of consciousness: to assume the existence of physical objects is useful in order to account for connections among the content of consciousness. The notion of the content of consciousness with which Wigner works is such that the content of consciousness is immediately accessible only to the person in question. He therefore maintains that the existence of other persons with a content of consciousness of their own is on the same footing as the existence of physical objects (pp. 37–42, 47, 63, 68, 248–254). Wigner admits, however, 'that I do not always think or speak in terms of the picture presented' (p. 40). Wigner's views on the interpretation of quantum mechanics should be seen against the background of this thesis of two kinds of reality.

2.2 Consciousness and the von Neumann chain

[147] Wigner's contribution to the interpretation of quantum theory centres around the measurement problem. He conceives this problem in terms of what is known as the 'von Neumann chain'. When von Neumann turns to measurement in Ch. VI.1 of his standard book on the formalism of quantum theory (1932), he describes what amounts to the following chain: we start with a quantum object an observable of which is to be measured. However, basing ourselves on the formalism of quantum theory and the Schrödinger dynamics in particular, we have to say that as a result of the interaction between the object and the measuring instrument, the object is entangled with the instrument. Consequently, the object is not in an eigenstate of the measured observable, and the instrument does not indicate a definite numerical value of that observable. Von Neumann extends this chain up to an observer. But if we take an observer into consideration, we simply end up with a description according to which the body of the observer including his or her brain is entangled with the instrument and the object. The measurement problem can be formulated as the question how a state reduction to one of the eigenstates of the measured observable can occur in this chain.

Wigner considers the measurement problem to be a genuine problem for the interpretation of quantum mechanics. All his statements on that matter exhibit a noteworthy intellectual honesty and openness. Throughout his papers he regards it as inevitable to assume that a state reduction takes place in measurement. He refuses to dissolve the measurement problem by countenancing a split of the world instead of a state reduction. Mentioning the many worlds interpretation, he dismisses the notion of a state function of the universe as senseless (pp. 68, 112). Nonetheless, Wigner rejects any solution to the measurement problem which claims that

macroscopic systems and measuring instruments in particular are not be described by quantum mechanics (pp. 50–51, 64–66, 256n.). Furthermore, he renounces all attempts to change quantum mechanics by introducing hidden variables (pp. 63–64, 107–115, 235–237).

Contemplating the von Neumann chain, Wigner claims that a measurement is not completed before consciousness is reached (pp. 35, 52). But he refuses to extend the von Neumann chain to the consciousness of an observer. He maintains on the basis of self-knowledge that there are no superposed states of consciousness. For instance, in a paper of 1973, he writes: 'It is, in particular, difficult to accept the possibility that a person's mind is in a superposition of two states […]. We ourselves never have felt we were in such superpositions' (p. 67). He concludes from statements like these ones that events of state reduction have to be admitted as occurring on the level of consciousness.

Wigner's proposal for a solution to the measurement problem hence consists in postponing the state reduction to the very end of the von Neumann chain: a state reduction is brought about only when the consciousness of an observer is reached (pp. 34–35, 251–252). Wigner thereby elaborates on a suggestion by London and Bauer (1939, § 11): consciousness randomly selects one product [148] state out of the superposition of product states and it thereby effects a state reduction. Wigner explicitly refers to the work of London and Bauer (pp. 34–35n., 52). He concedes that we do not have at our disposal a description of how a state reduction is effected by consciousness (pp. 35–36). Nonetheless, he suggests that the dynamics of quantum theory has to be modified in such a way that events of state reduction by consciousness are taken into account. In particular, in the paper 'Remarks on the Mind–Body Question' of 1961 (pp. 247–260), Wigner describes his proposal as amounting to 'the postulate that the equations of motion of quantum mechanics cease to be linear, in fact that they are grossly non-linear if conscious beings enter the picture' (p. 259; see also pp. 67–68).

In this context, Wigner raises a paradox for which he has become famous, namely the paradox of Wigner's friend: if one observer A considers another observer B, the friend, who makes an experiment on a quantum system and if the observer A describes this whole arrangement in the terminology of quantum mechanics, he will end up ascribing a superposition of different states of consciousness to observer B. Wigner proposes to avoid this paradox by maintaining that quantum theory does not apply to consciousness; consequently, there are no superpositions of different states of consciousness. He assumes that a state reduction takes place on the level of the friend's consciousness (pp. 53–54, 255–257). This point underlines that Wigner conceives state reductions as being caused by the consciousness of the first observer, whoever that first observer is.

2.3 Wigner's instrumentalism

It may seem that Wigner's proposal according to which a state reduction takes place only on the level of consciousness presupposes a realistic interpretation of quantum mechanics: the measurement problem invokes consciousness because quantum mechanics is universally valid in the physical realm including the realm of macroscopic objects. Consequently, physical systems objectively become entangled as described in the von Neumann chain. According to such a view, quantum mechanics describes physical systems and their development in time even if no measurement is carried out on them.

However, when Wigner discusses whether quantum mechanics should be interpreted in a realistic or an instrumentalistic way, he opts for the latter position. He maintains that the quantum state description is merely an instrument for the calculation of probability connections between observations and for the prediction of observations. By observations, he means in this context the content of the consciousness of the observer in question (pp. 34, 52, 62–63, 157, 161, 176, 219–220, 248–250, 568).[3] Wigner thus pushes instrumentalism to its limits: he adopts an instrumentalistic attitude towards quantum mechanics, and he subjects macroscopic instruments to a treatment in terms of quantum [149] mechanics too. He thereby refrains from admitting a classical description of macroscopic systems. Consequently, he refuses to subscribe to an ontological commitment to macroscopic objects such as laboratory instruments. The only ontological commitment which Wigner endorses is a commitment to the content of the consciousness of the observer in question.

2.4 Consciousness as the primary reality and Wigner's interpretation of quantum theory

Wigner frequently maintains that quantum mechanics on its own makes it necessary to refer to consciousness in physics (pp. 34, 36, 40, 42, 176, 248, 568, 598). However, considering the various options which one has in the interpretation of quantum mechanics, questions remain: Given von Neumann's formulation of the measurement problem, why does Wigner introduce a state reduction only on the level of consciousness? Why does he not, for instance, envisage a state reduction being brought about by the interaction between the quantum system and the measuring instrument? The stance which Wigner takes on the measurement problem can be explained as a consequence of his view that the content of consciousness is the primary reality. Given this philosophical presupposition, there is no reason to seek an interpretation or a modification of quantum theory which yields a description of a state reduction at some link within the von Neumann chain; for the only thing which counts for Wigner as an absolute reality is the content of the consciousness of an observer. Why does Wigner link his proposal for a solution to the measurement problem with an instrumentalistic instead of a realistic interpretation of quantum mechanics? Again the reason lies in that, for Wigner, physical objects have a reality only relative to consciousness. This presupposition prompts him to adopt an instrumentalistic attitude towards physical theories.

2.5 Wigner's later change of position

In his last papers on the interpretation of quantum mechanics from the late seventies and the first half of the eighties, Wigner changes his position to a considerable extent. Two reasons for this change can be extracted from his papers—a physical one and a philosophical one. The physical reason is the following one: Wigner is deeply impressed by arguments to the effect that macroscopic objects can never be considered as isolated systems. Wigner refers in particular to the work of Zeh (pp. 66, 75, 215–216, 271, 334, 338, 341, 583, 606, 615). For instance, in a paper of 1984, he says: 'This writer's earlier belief that the role of the physical apparatus can always be described by quantum mechanics […] implied that "the collapse of the wave function" takes place only when the observation is made by a living being—a being clearly outside the scope of our quantum mechanics. The argument which convinced me that

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3 A very clear statement of this position is also to be found in the paper 'Are we Machines?' (1969). See p. 484 in the reprint in Vol. 3 of the Collected Works.

quantum mechanics' validity has narrower limitations, that it is not applicable to the description of the detailed behaviour of macroscopic bodies, is due to D. Zeh' (p. 240).

[150] The philosophical reason for his change of position is that Wigner considers solipsism to be an implication of his earlier views on physical reality and the interpretation of quantum mechanics. Solipsism is already hinted at in some earlier papers as a possible consequence of quantum mechanics. In the paper 'Remarks on the Mind–Body Question', Wigner says that 'Solipsism may be logically consistent with present quantum mechanics, monism in the sense of materialism is not' (p. 252; see also pp. 34, 68). But it is only in later papers that Wigner takes the issue of solipsism to be a serious embarrassment. At the end of a paper published in 1977, he expresses the hope 'that quantum mechanics will also turn out to be a limiting case, limiting in more than one regard, and that the philosophy which an even deeper theory of physics will support will give a more concrete meaning to the word "reality", will not embrace solipsism, much truth as this may contain, and will let us admit that the world really exists' (p. 593). In a lecture of 1982, he then regards the issue of solipsism as a sufficient reason to repudiate his earlier views on measurement in quantum mechanics (pp. 73–74, and also p. 230).

In order to avoid solipsism, Wigner considers it to be necessary to admit state reductions independently of an observer's consciousness. And his conclusion, based on Zeh's argument, that quantum mechanics is not valid for macroscopic systems opens up the way for him to conceive state reductions when it comes to macroscopic systems. Changing his mind, Wigner makes a concrete suggestion for an amendment of the Schrödinger equation which is intended to describe a physical process of state reduction (pp. 75–77, 242–243). A state reduction is thus supposed to occur as an objective event in the physical realm before the von Neumann chain reaches the consciousness of an observer. It is a remarkable sign of intellectual vivacity that Wigner carried out such a significant change of his stance on the measurement problem when he was already more than seventy years old.

3. Critical Evaluation of Wigner's View of Physical Reality

3.1 Wigner's Cartesian epistemology

Wigner frequently claims that his view according to which the content of consciousness is the primary reality and the reality of physical objects is relative to consciousness is just obvious. For instance, in the paper 'Two Kinds of Reality', he says that 'there is a good deal of uneasiness in my mind—uneasiness that my point of view is so clearly correct that it is also uninteresting' (p. 40). Nonetheless, this view exhibits a strong influence on Wigner's thinking of a specific movement in philosophy—namely the logical positivism of the twenties and, more generally, the Cartesian tradition in modern epistemology. In Wigner's own words, 'positivistic philosophy means that we attribute reality only to what can be observed' (p. 138). Furthermore, in a paper of 1970 he claims that most physicists are positivists and says: 'A positivist, as I understand this [151] term, does not look for the "ultimate reality"; the observations, which I interpret to be the impressions he receives, are his prime concern' (p. 219).

As regards Cartesianism, Wigner speaks in connection with quantum mechanics of 'the return, on the part of most physical scientists, to the spirit of Descartes's *Cogito ergo sum,* which recognizes the thought, that is, the mind, as primary' (p. 248; see also pp. 564–565).

Although Wigner's proposal that consciousness causes state reductions implies a dualism in the sense that phenomena of consciousness do not supervene upon physical phenomena, he does not, like Descartes, conceive body and mind as two distinct entities (pp. 272, 609). However, Wigner's position that the content of consciousness is the primary reality shares at least two premises with the Cartesian tradition in epistemology including logical positivism:

- The object of knowledge is primarily the content of consciousness.
- The content of consciousness is independent of the external world in the following sense: the content of consciousness could be the same if the physical world were totally different from the way it actually is or even if there were no physical world at all.

Both these premises are strongly challenged in current epistemology:

- Many of today's philosophers maintain that things in the physical world are the direct object of knowledge including perceptual knowledge. The main argument, which goes back to Sellars (1956), is that even if there were basic contents of consciousness (such as sense data), they could not be both something simply given prior to conceptualization and a foundation which serves to justify knowledge.
- It is argued that the identity of beliefs depends on what qualitative character the physical world has in which the subject of these beliefs lives.[4] One thus cannot take the content of beliefs or the content of consciousness to be absolute and regard the reality of physical objects as being relative to the reality of beliefs.

These developments in contemporary epistemology have as yet by and large not been taken into account when claims about the observer and his mind or consciousness are made in the interpretation of quantum mechanics.[5] Considering these developments, the premises which Wigner takes to be obvious turn out to be questionable to say the least.

Over and above these developments a realistic approach to quantum mechanics has gathered momentum in the last decades. This new realistic approach does not settle for hidden variables. It abandons tenets of Einstein's realism such as the principle of separability, as becomes clear in, for instance, Howard (1989) and Redhead (1995).

[152] To sum up, Wigner's views on physical reality are influenced by a tradition in philosophical epistemology which extends from Descartes to logical positivism. Today, the situation has changed remarkably in philosophical epistemology as well as the interpretation of quantum mechanics. Therefore, in my opinion, Wigner's views on physical reality are as they stand not a plausible option today. Nonetheless, they are of historical importance since they show how a philosophical epistemology such as that one of logical positivism can contribute to shape a view on a physical theory such as quantum mechanics.

3.2 The measurement problem

Despite the sketched recent developments in epistemology and philosophy of physics, we still face the measurement problem.[6] Up to his last papers, Wigner maintains that notwithstanding progress in research into the formalism of quantum mechanics, the problems

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4 McCulloch (1995) is a good introduction to this argument.

5 A remarkable exception is Lockwood (1989) who examines and argues against central points of this contemporary, anti-Cartesian movement in the philosophy of mind.

6 For a reliable account of the state of the art, see Busch, Lahti and Mittelstaedt (1996) and Mittelstaedt (1998).

for the interpretation of quantum theory which von Neumann's description of the measurement process raises remain essentially the same. In his last paper in Volume 6 (from 1986), he says that 'our present quantum mechanics differs in its philosophical aspects little from that of Schrödinger' (p. 617) (where the last phrase refers to the Schrödinger equation including its relativistic generalisations).

However, to my mind, the way in which Wigner employs consciousness in the interpretation of quantum mechanics in order to make a suggestion for a solution to the measurement problem is not acceptable: according to him, no physical process is able to cause a state reduction. Consciousness is then invoked to do the job. But it remains entirely unclear how consciousness could cause a reduction of the state of a physical system. Note that this is not simply a special case of the general philosophical problem of mental causation: for if one countenances mental causation, one usually accepts that the power of intentions, so to speak, does not reach beyond the bodily powers of the person. That is: one maintains that some tokens of physical events are caused by intentions. But purely physical causes can bring about physical events of the same type. For example, sometimes I raise my arm intentionally, and sometimes purely physiological processes cause my arm to go up. In the case under consideration, by contrast, it is claimed that consciousness causes physical events which no physical process could bring about.

Hence, in my opinion, it is not a viable option to assume that consciousness causes state reductions. However, it is a possible option, which is endorsed by a number of today's physicists and philosophers of physics, to maintain that quantum mechanics including the superposition principle and the Schrödinger dynamics applies to all physical systems including macroscopic ones and to refuse to admit state reductions as objective events in nature. If one takes this [153] option, one is not committed to the consequence that we should experience superposed states of our consciousness. But one has to square the ensuing view of physical reality including macroscopic reality with our experience of a classical level of the world. One can say that a classical realm with no entanglement is only the way in which nature appears to us observers. One can connect this claim with the position that quantum mechanics without state reductions describes the whole physical reality by assuming that the observer has in fact many minds,[7] or that the observer abstracts from entanglement which is objectively there,[8] etc. Thus, it is still an open option to work with the observer's consciousness in the interpretation of quantum mechanics.

An analogous consideration applies to Wigner's later change of mind. His idea contains a viable option: If one considers it to be inappropriate to take recourse to the mind or consciousness of an observer in the interpretation of quantum mechanics and if one regards state reductions as objective physical events, it is reasonable to envisage a modification of the Schrödinger dynamics. The aim then is to achieve a more general dynamics that encompasses state reductions. The most elaborate suggestion in this respect goes back to Ghiradi, Rimini and Weber (1986).

To sum up, Wigner's earlier papers on the measurement problem and his later change of mind reflect the two principal options which we have: (a) we can regard quantum mechanics

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7 See, in particular, Albert and Loewer (1988) and Lockwood (1989, Chs. 12 and 13).

8 Compare, for instance, Landsman (1995).

including the superposition principle and the Schrödinger dynamics as universally applicable in the physical realm. In this case we face the problem how to square the ensuing view of physical reality with our experience. (b) We can maintain that state reductions occur in nature. In this case we face the challenge to develop a dynamics that accounts for state reductions. Because there is as yet no overall convincing physical solution to this latter problem, it is still an issue of philosophical argument which one of these two principal options one should adopt.

In conclusion, hermeneutic good-will notwithstanding, the solution to the measurement problem which Wigner proposes in his earlier papers is not plausible, and the framework on which his views on quantum mechanics and physical reality are based faces a serious challenge in today's philosophy. Nonetheless, the papers assembled in Volume 6 of the Collected Works provide an excellent discussion of the conceptual problems with which any interpretation of quantum mechanics has to cope. In order to evaluate the situation and the options which we face today, it is indispensable to get a clear understanding of these problems. No student of the philosophy of quantum mechanics should therefore ignore Wigner's papers on that matter.

References

[154] Albert, D. Z. and Loewer, B. (1988) 'Interpreting the Many Worlds Interpretation', *Synthese* **77**, 195–213.

Busch, P., Lahti, P.J. and Mittelstaedt, P. (1996) *The Quantum Theory of Measurement*, 2nd edn (Berlin: Springer).

Ghiradi, G., Rimini, A. and Weber, T. (1986) 'Unified Dynamics for Microscopic and Macroscopic Systems', *Physical Review* **D 34**, 470–491.

Howard, D. (1989) 'Holism, Separability, and the Metaphysical Implications of the Bell Experiments', in J. T. Cushing and E. McMullin (eds) *Philosophical Consequences of Quantum Theory. Reflections on Bell's Theorem* (Notre Dame: University of Notre Dame Press), pp. 224–253.

Landsman, N. P. (1995) 'Observation and Superselection in Quantum Mechanics', *Studies in History and Philosophy of Modern Physics* **26**, 45–73.

Lockwood, M. (1989) *Mind, Brain and the Quantum. The Compound 'I'* (Oxford: Blackwell).

London, F. and Bauer, E. (1939) *La théorie de l'observation en mécanique quantique* (Paris: Hermann). English translation in Wheeler, J. A. and Zurek, W. H. (eds) (1983) *Quantum Theory and Measurement* (Princeton: Princeton University Press), pp. 217–259.

McCulloch, G. (1995) *The Mind and its World* (London: Routledge).

Mittelstaedt, P. (1998) *The Interpretation of Quantum Mechanics and the Measurement Process* (Cambridge: Cambridge University Press).

Neumann, J. von (1932) *Mathematische Grundlagen der Quantenmechanik*. Berlin: Springer. English translation *Mathematical Foundations of Quantum Mechanics* (Princeton: Princeton University Press, 1955).

Redhead, M. L. G. (1995) *From Physics to Metaphysics* (Cambridge: Cambridge University Press).

Sellars, W. (1956) 'Empiricism and the Philosophy of Mind', Minnesota Studies in the Philosophy of Science **1**, 253–329. Reprinted with an introduction by Richard Rorty and a study guide by Robert Brandom (Cambridge, Mass: Harvard University Press, 1997).