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DEPARTMENT OF MATHEMATICS

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original send to HE III

Jew
15 Apr

April 9, 1957

Professor John A. Wheeler
Mr. Hugh Everett
Palmer Physical Laboratory
Princeton
N. J.

Gentlemen,

I have received the two papers you have sent me and intend to give you a more detailed report on them by May 1st. In the meantime I want to give you my first impressions. These are that the inclusion of the observer as an intrinsic part of the observed system is absolutely sound. Namely, I see no way of bringing into quantum theory the concept that something particular actually happens without introducing an observer as part of the quantum-theoretical system. Matter of fact quantum theory as a partly probabilistic theory without actual occurrence does not seem to me to make sense. Perhaps I may say as you do: the probability in quantum theory must have the properties of true Lebesgue measures. Nevertheless, the particular things that happen in the universe are mostly not directly accessible to us, and the individual occurrences of probability, where directly observed, must be those in a subsystem which we call the observer. In my opinion it is essential for a usable theory that this

I never said that!

observer must represent a very thin selection of the larger universe which he is observing, so that under certain circumstances we are justified in treating the observation which he makes, which may theoretically not be fully independent, as if it had a full property of independence. Roughly speaking, the observer must be something like a human retina which over one very short interval of time only receives impressions of a relatively small part of the universe. Eventually the small parts and their memories add up to a very good representation of the universe.

In other words, I am sympathetic of your point of view, while I think that your discussion of it meets one essential difficulty which I believe is removable. It is this that the whole basis of your quantum theory is Hilbert space, and in Hilbert space, as it is universally understood, there is no true Lebesgue measure. It is just because of this that I have been forced to introduce the notion of differential-space into quantum theory. (A New Form for the Statistical Postulate of Quantum Mechanics, N. Wiener and A. Siegel, Phys. Rev., Vol. 91, No. 6, September 15, 1953, p. 1551. - The Differential-Space Theory of Quantum Systems, N. Wiener and A. Siegel, No. 4 del Supplemento al Vol. 2, Ser. X. del Nuovo Cimento, pp. 982-1003, 1955. - Fourier Transforms in the Complex Domain, R. E. A. C. Paley and N. Wiener, American Mathematical Society, New York, 1934, Chap. 9. - N. Wiener, Acta Math. 55, 117-258, 1930, Sec. 13. - N. Wiener, J. Math. and Phys. 2, 131, 1923)

*I do not need
Leb. measure in
Hilbert space.
whole problem
neatly avoided
by my treatment
of my measure
on trajectories, i.e.
on orthogonal states, not
entire H. space.*

This is a space in which there is a true volume and which therefore is clearly distinct from Hilbert space, but is so related to Hilbert space that every unitary transformation of Hilbert space generates a measure-preserving point transformation with the associated differential-space.

In theory the universal state function is the realized fact.

In superposition after measurement all elements actually realized.

I am fully aware that this question of "actualization" is a serious difficulty for current Q.M., and does in fact one of main motives for present formulation.

No problem in present form, however.

no such statements ever made in theory
like "case A
actually realized," except
relative to some other state.
"All possibilities
already realized," with correct observer states.

Another point where your theory needs amplification (although I imagine that you are fully aware of that, since your theory is a meta-theory; as such, amplification is necessary) is that I do not find an adequate discussion of what it means to say that a certain fact or a certain group of facts is actually realized. Dr. Siegel and I have been working in this field as you will see by the articles. However, as you proceed at your work, I am convinced that you yourself will have to attack this problem.

In short, I think you have made a real contribution to a possible future quantum theory, particularly in your insisting that the observer be an intrinsic part of the quantum system. However, you will have to go much further before you have rendered this suggestion into something concrete and usable. If I may be allowed to coin a word: I do not think that you have even yet formulated a meta-theory, but simply a set of prolegomena to a future meta-theory.

I hope that you will go on with your work, and I wish you all success. I certainly think that your

paper should be published, but more as comments on the present intellectual situation than as a definitive result.

Sincerely yours,

Norbert Wiener

Norbert Wiener.

NW/lS

Enclosure: 1 reprint

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where?