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An Evolutionary Picture for Quantum Physics

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Dedicated to the memory of Misha Polivanov who strove to conserve a cultural heritage in dark times

Abstract: In the orthodox language of Quantum Mechanics the observer occupies a central position and the only "real events" are the measuring results. We argue here that this narrow view is not forced upon us by the lessons of Quantum Physics. An alternative language, closer to the intuitive picture of the working physicist in many areas, is not only possible but warranted. It needs, however, a different conceptual picture ultimately implying also a different mathematical structure. Only a rudimentary outline of this picture will be attempted here. The importance of idealizations, unavoidable in any scheme, is emphasized. A brief discussion of the EPR-phenomenon is added.

1. Language and Philosophical Extrapolations

Prominent in the vocabulary of Quantum Theory are the words "physics systems," "state," "observable," "measuring result." The general theory tells us how these terms are represented in the mathematical scheme and it tells us the following: *If a system S is in a state s and we measure the observable A then the probability of obtaining the result a is given by the formula* $p = \mathrm{tr}\, sP_a^{(A)}$. I shall not explain the formula since you know it all.

This language has proved to be very efficient in a wide area. Nevertheless we should not consider it as sacrosanct. There are limits to its usefulness and every word in the vocabulary is subject to criticism.

Let us start with the word "observable." It suggests that there is an observer. Does this have to be a human being? Certainly in the discussions of the early days of Quantum Mechanics no other interpretation was intended. One of the concerns of Niels Bohr was epistemology, i.e. the question of what we (humans) can know and how we can communicate. But even if we want to understand the word observer in a wider sense we must endow him at least with the faculties of consciousness, intelligence in planning and free will in execution. So there is the question: does Quantum Physics force us to abandon the old picture of a real outside world, called nature, which exists separate from our consciousness? Do the findings of atomic physics decide in favour of some philosophical system like positivism or idealism