

John Eccles' Struggle for a Dualistic Mind-Brain Relation

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Abstract

We experience the world through our sensory organs, and translate these impressions into our ideas of nature's functional behaviour. Experience tells us that our actions lead to a unique and predetermined result: the thrown ball stays in its calculable trajectory which is determined by gravitation and air friction. Natural processes, e.g. earth quakes or volcanic eruptions, are, however, not always predictable. The reason is the complex situation in which many unknown parameters enter the game. Nevertheless, we believe that also such processes follow deterministic laws.

This situation leads to the mind-brain problem. Even when the brain, this most complex structure of biological evolution, is non-calculable in its dynamical reaction on external stimuli, we believe that, contrary to the deterministic processes in nature, our will allows us free actions which we can freely impose on our brain: the self controls the brain!

The struggle between determinism and self-consciousness marks the source of difficulties which occupied John Eccles throughout his scientific career, and which he saw coming to a wonderful solution during the last decade of his life.

Descartes dualism, which was the first rational formulation of dualism and interactionism: 'cogito ergo sum' - I am thinking, so I am existing - run into a seemingly irresolvable contradiction when natural science succeeded to derive all processes in nature from deterministic and causal natural laws. How can the mind control the brain when this material entity underlies the causal dynamics of nature? Materialism has a quick answer at hand: the independent mind, or self, is nothing more than an artefact of the complex and non-calculable brain dynamics. The brain is an autonomous structure which determines its actions from the complex stimulus-reaction mechanism, additionally predetermined by life-long learning processes.

This materialistic concept was originally criticised by John Eccles for purely logical reasons. How can the brain with its myriads of possibilities of the genetic lottery produce self-consciousness in each human individuality? Together with Karl Popper, he then developed the dualistic concept of the control of Popper's World 1 by World 2. There was left, however, the open question how such a control would be possible since World 1 is closed under the deterministic and causal laws of nature. In the language of modern physics, these laws result from empirically well established conservation laws (such as, e.g., energy conservation) which are strictly fulfilled for closed systems. Some protagonists of the mind-brain puzzle, among them A.S. Eddington, Erwin Schrödinger, and last not least also Karl Popper, proposed a way out by the assumption that the mind violates in a minute amount the conservation laws, and in this way establishes an interaction between World 2 and World 1. Eccles regarded this solution as unsatisfactory and did not engage on it.

A completely new aspect came with quantum physics whose laws rule the regime of atoms and molecules. Because of this microscopic world, not visible with the naked eye, quantum logic is not easy to grasp with our experience derived from the macroscopic world. But in

quantum physics the future is no longer, as was the case in classical physics, determined by the presence in a strictly causal way. Unique single events are replaced by a series of possible events which in Popper's language are called 'propensities'. They are entangled by a probability amplitude, and none of the possible outcomes violates any conservation law. But which one of the various propensities will finally be realized does not follow from the laws of quantum mechanics which predict only the probability amplitudes. In a single event the outcome is completely open! Could it be that this non causal openness of quantum physics plays a role in brain dynamics? And could this then be the relevant mechanism through which the self controls its brain in a dualistic and interactionistic manner? The first question is of a purely biophysical nature. That the answer can be positive in accordance with the laws of quantum mechanics and neurophysiology offers the keystone for a positive answer also to the second question. Having found this keystone was for John Eccles, at the end of a long period of seminal scientific achievements, the all overwhelming event in his life-long search for a dualistic solution of the mind-brain problem.

The lecture will touch all these questions, starting with a brief outline of quantum logic and its implications, and will then explain the implementation of the quantum trigger model into synaptic brain activity. Finally we present John Eccles' psychon hypothesis as the locus for the interaction between mind and brain.