

Chapter 7

The Quantum Interaction Between My Own Mind and My own Body

To account for the quantum interaction between my own immaterial mind and my own material body, it would contribute to the specificity of our solution if we first spell out what lies at the heart of the problem. We turn to ryle and repeat what he has captured about the problem of mind-body interaction:

Even when 'inner' and 'outer' are construed as metaphors, the problem how a person's mind and body influence one another is notoriously charged with theoretical difficulties. What the mind wills, the legs, arms and tongue execute; what affects the ear and the eye has something to do with what the mind perceives; grimaces and smiles betray the mind's moods and bodily castigations lead, it is hoped, to moral improvement. But the actual transaction between the episodes of the private history and those of the public history remain mysterious, since by definition they can belong to neither series. They could not be reported among the happenings described in a person's autobiography of his inner life, but nor could they be reported among those described in someone else's biography of that person

overt career. They can be inspected neither by introspection nor by laboratory experiment. They are theoretical shuttlecocks which are forever being bandied from the physiologist back to the psychologist and from the psychologist back to the physiologist.¹

Ryle's problem of finding it a mystery in pinpointing the location of mind-body transaction can be given a solution within the framework of a quantum interaction. It will be recalled that the understanding of quantum mechanics requires that we make at least two fundamental assumptions. The first assumption concerns the idea that quantum entities enjoy no actual existence prior to the act of measurement. A quantum entity such as an electron does not have the status of an ordinary object when left to itself (even the use of the pronoun "itself" is inappropriate since an electron prior to being observed has no identity, but will have to be allowed for convenience's sake). The second assumption may be called the "consciousness requirement". The quantum itinerary of each sub-atomic particle will remain "fuzzy" without the intrusion of the act of measurement, which can be specified as a conscious measurement or a measurement by a conscious mind. This specification receives its justification from the fact that without any reference to consciousness, the act of measurement

¹Gilbert Ryle, op. cit., p. 14.

which brings about the collapse of the wave function and translates quantum potentiality into macro-world actuality acquires the unnecessary difficulty of being faced with a regress. For if a material apparatus qualifies as an observer or measurer, an infinite regress looms for the simple reason that material objects are themselves composed of quantum entities which behave according to quantum laws and which also require the collapse of their wave functions. Without consciousness to terminate such a regress, the collapse of the quantum wave function by a machine observer will be asymptotic, that is, unapproachable.

It must be emphasized that the consciousness requirement does not make it a foregone conclusion that the mind-body interaction problem will be solve quantum mechanically. Nor does it make it the case that quantum dualists have cheated by assuming that consciousness has the potency to collapse the wave function and produce concrete objects out of fuzzy particles. The important point to note is that while the consciousness requirement is no stranger to quantum theory, there is nothing in this requirement which provides a clear description of the mind-body interaction. All that the consciousness requirement says is that the quantum collapse of the wave function requires the presence of a conscious mind. How the collapse happens which seems to be an important factor in explaining mind-body interaction has remained something of a mystery, as already noted in the chapter on quantum mechanics. If the question is to be begged

against materialists or anyone objecting to the necessary reference to consciousness in quantum mechanics, then it will only be a question of assuming outright that there is such a thing as consciousness and this consciousness is different in kind from matter in such a way that it does not require for its own actuality the quantum collapse of wave functions. But it seems obvious that the content of the question that will have to be begged is no more than the substance dualist's initial assumption that fundamentally there are or least two things and one of them is mind or consciousness.

Our attempt to describe how my immaterial mind can act on my material body and how my material body can, in turn, act on my immaterial mind will proceed from the two assumptions alluded to. First, according to the first assumption, there is no actual existence in the quantum state. To be more specific, the contrast between something being actual and something being non-actual of less than actual can be brought out this way:

Bohr said that no elementary quantum phenomenon is a phenomenon until it has been brought to a close by an irreversible act of amplification. The key feature here is that if we are observing or measuring a quantum system, which is usually something very small, for example the position of an electron, then at the end of the day... we will normally want to discuss something big, macroscopic and uncontentious, like a click on a

Geiger counter. The act of going from the microsystem, which...is a fuzzy, rather indeterministic thing, to this big macrosystem, which we all feel is in some sense a well-defined state with a concrete existence, is clearly an act of amplification. But the crucial point is that it is also irreversible. Bohr regards this irreversible act of amplification, the stage at which one can say that a phenomenon has come into being, as in some sense generating reality...²

The contrast between macroscopic actuality and microscopic indeterminacy is reminiscent of and can be paraphrased in terms of the Aristotelian contrast between potentiality and actuality. Without, of course, claiming any strict equivalence between the concept of Aristotle and quantum indeterminacy, the point made here is that in trying to understand the iconoclastic implications of quantum mechanics, some physicists even go back to the field of philosophical concepts and glean what can help elucidate the paradoxical features of quantum experiments. Heisenberg is one of them, and his attempt to describe in common-sense language the structure of matter in terms of the notion of "potentia" is of great relevance to our problem:

²Paul Davies, "Time Asymmetry and Quantum Mechanics" in the Nature of time, ed. by Raymond Flood and Michael Lockwood (Basil Blackweel, Oxford, 1986), p. 99-100.

...in the philosophy of Aristotle, matter was thought of in the relation between form and matter. All that we perceive in the world of phenomena around is formed matter. Matter is in itself not a reality but only a possibility, a "potentia"; it exists only by means of form. In the natural process the "essence," as Aristotle calls it, passes over from mere possibility through form into actuality. The matter of Aristotle is certainly not a specific matter like water or air, nor is it simply empty space; it is a kind of indefinite corporeal substratum, embodying the possibility of passing into actuality by means of the form. The typical examples of this relation between matter and form in the philosophy of Aristotle are the biological processes in which matter is formed to become the living organism, and the building and forming activity of man. The statue is potentially in the marble before it is cut out by the sculptor.³

In contrasting the body and the soul in *De Anima*, Aristotle brings out the idea of something being potential and something being actual, which is captured by the earlier passage from Heisenberg:

³Werner Heisenberg, Physics and Philosophy: The Revolution in Modern Science (Penguin Books, Baskerville, 1989), p. 135-136.

1. Under the heading of substance we speak of (A) matter, (B) form, in virtue of which matter constitutes a particular thing, and (C) the compound of matter and form.
2. As received opinion has it, bodies, and in particular natural bodies, are what primarily exist. Of these natural bodies, some have life, which is the power to nourish oneself and grow and so also decay. Therefore, every live natural body is a composite substance.
3. Every body thus partaking of life is a substance of type C. Therefore, since it is a certain sort of body (that is, since it is a body with life),
4. The body is substratum and of type A, and not of type B.
5. Therefore, the body is not the soul.
6. The soul is a substance of type B; that is, it is the substance (in the sense of form) of a potentially live body.
7. Substance-form is actuality.
8. Therefore, the soul is the actuality of a potentially live body.⁴

⁴Edwin Hartman, Substance, Body, and Soul: Aristotelian Investigations (Princeton University Press, New Jersey, 1977), p. 132-133.

It is not imperative for this project to delve into what Aristotle has analysed as "body" and "soul". It is enough for our concern to allude to the Aristotelian notion of potentiality and actuality. In the framework of quantum mechanics, the "ghostly" state of quantum objects can be equated with "potentia" or the realm of possibilities:

Quantum theory according to the Copenhagen interpretation represents the world in two different ways: the observer's experience is expressed in the classical language of "actualities", while the unmeasured quantum realm is represented as a wavewise superposition of "possibilities". Heisenberg suggests that we take these representations literally as a model for the way things really are.

Thus, according to Heisenberg's duplex vision, the unmeasured world actually is what quantum theory represents it to be: a superposition of mere possibilities (Heisenberg called them "potentia"), unrealized tendencies for action, awaiting the magic moment of measurement that will grant one of these tendencies a more concrete style of being which we humans experience as actuality.⁵

⁵Nick Herbert, Quantum Reality (Anchor Books, New York, 1987), p. 194-195.

Intuitively, we seem to have no problem understanding what it is for something to be actual. Ordinary objects are paradigmatic of things being actual. The actuality of something is the real existence of that thing as understood in the common-sensical, macro-world context. Potentiality or possibility is, on the other hand, more obscure, although it is not unfamiliar in our everyday affairs. We understand what is meant by "possible outcomes" of some state of affairs. We think we know what is being conveyed when someone says, for example, that such and such projects have the potential for growth. The kind of possibility which characterizes the quantum wave function is not so esoteric as to be totally unconnected with our common-sense intuition. Although it has been emphasized that the quantum world, if one may call it a world, seems to be governed by laws that challenge the foundation of classical Boolean logic, it does not have to be the case that the reasoning and conceptual models that we are acquainted with and use are completely inapplicable to the quantum situation or to our understanding of it.* On the contrary, the quantum

*According to Schroedinger, "Physics takes its start from everyday experience, which it continues by more subtle means. It remains akin to it, does not transcend it generically, it cannot enter into another realm. Discoveries in physics cannot in themselves--so I believe--have the authority of forcing us to put an end to the habit of picturing the physical world as a reality. Erwin Schroedinger, Science, Theory, and Man (George Allen and Unwin, 1953), p. 204.

interpretation problem exemplifies our attempt to bridge the conceptual gap between the micro-world of quantum mechanics and the classical world of our everyday experience. Heisenberg's version of such an interpretative attempt exemplifies the kind of reasoning which explores the possibility of a literal ontology for a world beyond sense-perception. Moreover, in our attempt to provide a philosophical analysis of a certain phenomena that takes into account the findings of quantum mechanics, we have to consider three important and interconnected factors, namely, 1) quantum facts, 2) quantum theory, and 3) quantum reality:

All quantum experiments consists of commonplace events, a fact I call the Cinderella effect. The world may really be as strange as some physicists say, but it does not flaunt this strangeness, evidently preferring to hide its magic--like Cinderella--in humble guise. The Cinderella effect itself is a subtle example of quantum weirdness: why does nature employ such extraordinary realities to keep up merely ordinary appearances?...

Quantum facts are indeed ordinary. But quantum theory--the only complete explanation we possess of these facts--is decidedly non-ordinary. Since quantum theory fits the facts exactly, many physicists are sure that it bears some relationship to reality itself: such a perfect match between theory and fact is no accident. Physicists come up with different pictures of quantum

reality depending on what aspects of quantum theory they decide to take seriously and which parts they discard as mere mathematical figures of speech.

Quantum reality doesn't show up directly in the quantum facts: it comes indirectly out of the quantum theory, which perfectly mirrors these facts..⁶

In the context of our mind-body interaction problem, the quantum facts include everything we intuitively and experientially know about the contents of our own minds and bodies and their interactive scenario. We may also incorporate knowledge in psychology and physiology into the category of quantum facts. the fact that when I want to take a sip from a can of beer and eventually do so is empirically on a par with the appearance of a dark spot on the phosphor screen after an electron has struck it, both being commonplace, macro-events of our everyday world. In this sense, quantum reality would be descriptive of the existence of minds or mental substance, the existence of the "ghostly" world of fuzzy sub-atomic particles, and the unceasing discourse between the two, out of which common-sense reality is generated. Our quantum theory, then, would consist in providing an explanatory model that would fit the quantum facts.

⁶Nick Herbert, op. cit., p. 56-57.

Chapters 5 and 6 have already set the stage for thinking of the mind-body interaction in terms of the collapse of the quantum wave function by consciousness, this collapse bringing about actual states of affairs out of myriad of quantum possibilities. In the chapter on Thermodynamic time, it has been suggested that the collapse of the wave function is intimately connected with irreversible time which is manifested by the increase of disorder, called entropy. Further, the mind, or rather, my own mind is said to be interwoven into the fabric of time. The awareness of the flow of time is a distinguishing mark of consciousness. In addition to the intentional criterion of the conscious mind, it has been noted that to be conscious is not only to be conscious of something but also to be conscious of that thing being subject to time's current.

The nexus of the interaction between my own immaterial mind and my own material body can be described by first considering how we relate our notion of possibility to our notion of actuality in an ordinary way. A paradigm of invoking a possibility is giving a promise. It may be claimed that not only is a promise neither true nor false, but it is only a verbal gesture that has nothing at all to do with ontology, much less with the interaction between two things. If we are not talking quantum-mechanically, such a comment may have force. However, even leaving the quantum perspective temporarily aside, it may also be pointed out that in the field of action and agency, a promise can make a difference in both the present and the

future, and if the present and the future are thought of in terms of a temporal ontology, then a promise is neither ontologically neutral or irrelevant.

If I promise you that when the clock strikes the hour I will give you half of the money in my pocket, it seems that I not only alter my present and future monetary status, but I also alter yours just as well. The way in which my present monetary status is altered by such a promise has to do with the constraint placed directly on my current action before the clock strikes the hour. Because of the promise, at least I am constrained by the fact that if I were to honor my promise I cannot spend more than half of what I now have. The monetary status of my future right after the clock strikes the hour will be altered by the fact that if I were to honor my promise I would only have half the money I have now. Similarly, if I were to keep my promise, you will be richer when the clock strikes the hour, and more importantly, your current monetary status will also have shifted for the better. Imagine a scenario in which a loan shark is about to slit your throat for what seems to him to be a default on your part on a debt. Now, with my promise, you can plead with the loan shark to defer your execution until after the clock has struck the hour, by which time you would already be in the position to appease him with some repayment. According to this scenario, the promise that I give to you

has become significant and "tangible" enough to be able to prevent your death.

A promise is ontologically relevant in the sense that it carves out a certain state of affairs of which the content of the promise is about. Of course, such a state of affairs is not yet actualized, but it will inevitably be, given what a promise is supposed to be by definition. While it remains unactualized, the promised state of affairs exists as a possibility among infinite possibilities. But just because it is only a possibility does not mean that it is ontologically impotent, as suggested by the above example. The state of affairs embedded in the content of a possibility is not yet a concrete event, but it is not a nothing either, for how can a nothing have the power to constrain action. When we transfer the notion of possibility to the level to which quantum mechanics is applicable, this notion is represented by wave mechanics which encodes the information concerning all possible states of a given particle. It is normal to think of the wave mechanics or wave function as an abstract mathematical object which has its utility in the calculation of the changes of the attributes of the quantum entities. However, as it is with other paradoxical features of quantum mechanics, to say that the wave function is nothing but a mathematical gadget is not to capture the whole truth or to explain why something mathematical can be collapsed to generate reality. Concerning this tendency to take only an abstract view of

mathematical entities^{*}, Schroedinger warns:

The waves, so we are told, must not be regarded as quite real waves. It is true that they produce interference patterns--which is the crucial test that in the case of light had removed all doubts as to the reality of waves. However, we are now told that all waves, including light, ought rather to be looked upon as probability waves.' They are only a mathematical device for computing the probability of finding a particle in certain condition, for instance... the probability of an electron hitting the photographic plate within a small

^{*}One alternative philosophy of mathematics is the realist or Platonic option. This alternative "maintains that mathematics really exists-- 'p' really is in the sky--and mathematicians simply discoveres it. Mathematical truth exists independently of the existence of mathematicians. It is a form of objective universal truth. Thus the reason why mathematics is so successful in describing the way the world works is because the world is at root mathematical... Most scientists and mathematicians operate as if platonism is true, regardless of whether they believe that it is. That is, they work as though there were unknown realm of truth to be discovered...Particles physicists are the most deeply platonic because their entire subject is built upon a belief that the deepest workings of the world are based upon symmetries..." John D. Barrow, op. cit., p. 183-185.

specified area. There it is registered by acting on a grain of silver bromide. The interference pattern is to be regarded as a statistical registration of the impinging electrons. The waves are in this context sometimes referred to as guiding waves--guiding or directing the particles on their paths. The guidance is not to be regarded as a rigid one; it merely constitutes a probability. The clear-cut pattern is a statistical result, its definiteness being due to the enormous number of particles.

Here I cannot refrain from mentioning an objection which is too obvious not to occur to the reader. Something that influences the physical behaviour of something else must not in any respect be called less real than the something it influences--whatever meaning we may give to the epithet 'real'...⁷

In the light of Shroedinger's caution, then, we will consider the wave function as being on an ontological par with other quantum objects. Just as the word "electron", for instance, is applied neither to a definite object nor to a mathematical fiction, but rather to a potential or possible being which inhabits the realm

⁷Erwin Shroedinger, op. cit., p. 197-198.

of quantum-mechanical indeterminacy, the possibilities represented by the quantum wave function will be understood not merely as mathematical information regarding probability, but as real possibilities analogous to those spoken about and experienced in the macro-world, something, as Heisenberg has suggested, that stands between the idea of an event and the actual event itself.

It is necessary to try to circumvent the charge of confusing concept with ontology, for an objection may be raised to our giving an ontological status to a modal concept. In the example given, it may be said that what prevents your throat from being cut by the loan shark is not some tangible possibility of his being paid, but only his belief that he will get his money back. Without getting bogged down in epistemological disputes, suffice it to say that for a belief to be true, it must at least be based either on other true beliefs or on true states of affairs.* Unless we are willing to be captured in a kind of epistemological solipsism in which the basis of each belief is

*States of affairs include relations between entities, aspects of things, e.g., "the redness of Mary's hair, my ability to speak French, there being ravens, John's proximity to Mary, John's way of walking, and the possibility of her death." Michael A. Slote, *Metaphysics and Essence* (Basil Blackwell, Oxford, 1974), p. 70.

found in another belief and so on to the point of circularity, we should allow the fact that beliefs are justifiable by actual and possible states of affairs. Applying this allowance to the case of the loan shark, his deferral of your execution would not be just a conceptual matter, that is, a matter of his belief, but rather a joint commitment between his belief and an independent possible state of affairs which is the basis of his belief. But a possible state of affairs is nothing more than a possibility.

The reality of possibilities can be understood in these terms:

What are possibilities? What do they explain. When philosophers think about possibilities, they think about the changes that occur in things. Anyone who thinks the only changes that can occur to things are changes of their positions will not think about either possibilities or the past except to wonder where things might have been or where they might be made to go. When philosophers think about something becoming different from what it was, however, many of them think that the change involves possibilities. The thing is what it is, but it can also change. It can come to have different properties and relations. What it can become--not just what it will become--are possibilities. Possibilities are the properties and relations that a thing does not

now possess but that are, in some special way, relevant to it. They are real, even when they are not possessed by the thing for which they are possibilities or, perhaps, by anything. They are real because things can change and possibilities are the entities that can constitute their change. So if it is possible for thing to change, what can come about in them must be real before it in fact comes about. What comes about in things could not have come about from nothing; that would be impossible. If a thing can become an X,Y, or Z, it is not impossible. for it to become anyone of them. The X,Y, and Z, therefore--the whats that can possibly come about in the thing--are real.^a

But if possibilities are real, they are surely not real in the sense that tables and chairs are real. However, it is just because possibilities are not real in such a way that they can exist as modality in our minds. Again, to repeat Heisenberg's point, possibilities stand in between the idea of an event and the event itself.

In the context of quantum descriptions of sub-atomic particles, then, the possibilities represented by the quantum wave function can

^a Irwin C. Lieb, Past, Present, and Future: A Philosophical Essay About Time (University of Illinois Press, Chicago, 1991), p. 116.

be viewed as the possibilities or possibilities for the particles to change their attributes. But the particles can also be understood in terms of "potentia" also, since these entities in the quantum state are exemplars of indeterminacy awaiting actualization by the act of conscious measurement. We can try to visualize the situation by graphically depicting a quantum entity with a potential to become a well-defined electron as being spread out ontologically into a wavefront. The wave and the entity are one, but the wave represents all possible states the entity can be in. The entity cannot be made to represent itself in all these possible states because such a representation requires wave-like properties. The situation is like putting a huge amount of information compressed in unreadable form within a micro-dot on a scroll of paper. The dot and the scroll contains similar information, but serve different purposes. The difference is that while the wave function contains information about the potential electron, the scroll does not contain information about the dot, but rather information that has been in the dot.

In any event, the significant point is that if quantum objects are equivalent to possibilities, their accessibility by the mind should pose no obstacle. For it is intuitively certain that one important activity of my own mind is that which explores the possibilities still unactualized as well as the dead alternatives which have once been possibilities. My mind moves back and forth between things and events of my possible futures and my irreversible

past. Moreover, it is also possible for my mind to imagine possibilities that belong to my past but are not dead alternatives, for these have never been any part of my past alternatives in the first place. Yesterday I could have read a different book but instead took up a very boring one to read. The book left unread is my dead alternative. But the fact that I could have gone to Bali instead of reading had never been a real alternative yesterday. I did not even think of going to Bali yesterday. Of course, the possibility of my going to Bali existed yesterday regardless of the fact that it did not enter my mind. But that possibility was not my real alternative. Yet, today I think of such a possibility, of being in Bali not in the future, not next week, but of being in Bali yesterday. Skeptics would attribute this possibility to my imagination, not realizing that such an imagination is also a part of what seems to be mysterious about the mind.

As a substance which is one of the fundamental constituents of Nature, my own mind is permeated with both possibilities and the flow of time. At the quantum level, as we have already seen, all processes are reversible in time because nothing is actualized until consciousness intrudes. Past, present, and future has no relevance in the realm of quantum entities. But time also flows. This fact is given in experience and is as fundamental as any experiential item can be. Time is also objective in the way that a force field is objective. The force field of time is its currents as manifested by the

increasing entropy of the Second Law of Thermodynamics. Macro-objects tend towards increasing disorder because time at the macroscopic level flows in the direction of entropy. The point of transaction which seems mysterious to Ryle is this: the transference of one of the possibilities represented by the quantum wave function by the act of consciousness to the actual flow of time, the currents which render meaningful our notion of past, present and future.

This transference would be equivalent to the collapse of the wave function. What seems mysterious to Ryle, namely, the mind-body transaction, is the same problem of measurement which seems mysterious to quantum physicists. What takes place when the quantum wave function collapses? This is our scenario: My brain is a quantum entity. By the standard of quantum size, the brain's neurons are macroscopic. The quantum entities of my physical brain are just the regular sub-atomic particles that make up the physical universe. In the complex configuration of these quantum ingredients, the underlying structure of my brain is a manifold of wave functions. My mind comes into contact with my brain by way of the flow of time. My mind is cognizant of time's flow and is in contact with time's currents. At the same time, my mind is also capable of exploring possibilities. The simultaneous contact that my mind makes with a quantum possibility and the flow of time is the collapse of the quantum wave function. This is the point when a quantum potential is transferred to the level of macroscopic existence. The collapse of the wave function can also

be described as the contact between the flow of time and a quantum possibility at the interface of my mind. The crux of this mindbrain transaction lies in the assumptions that quantum realm is impervious to time's flow which makes past, present and future experientially real and that the contact of this temporal flow with a quantum possibility subjects the latter to the flow of things becoming present and then past, with the present plowing into the future. Conversely, a stationary observer can visualize the future as flowing towards the present and then past. It is not important for our problem how the relation between time and the observer is laid out. The crucial point to note is that the temporal direction terminates the quantum possibilities. This is the meaning of both the collapse of the wave function and the time irreversibility of Thermodynamics. This is the cause of the transience of life. And eternity may be nothing more than the indeterminacy of the quantum world.

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