BODY AND MIND.

ALL unsophisticated people believe that their minds act on their bodies and their bodies on their minds. If some one sticks a pin into me and I feel a painful sensation, it seems obvious that the entry of the pin into my body is the cause of the sensation in my mind. Similarly if I will to move my arm it seems obvious that the volition in my mind causes the movement of my body. The view that mind acts on body and body on mind may be called "two-sided interactionism."

In spite of the fact that interactionism seems at first sight to be certainly true, we have to notice that it is at the present time rejected by what is probably a majority of scientists and a majority of philosophers. Most people who have studied the subject from the side either of philosophy, or of physics, or of physiology have come to the conclusion that the mind does not act on the body and that the body does not act on the mind. Such a strange conclusion and one so contrary to the belief with which we all start must need powerful arguments to support it; and what I propose to do in this paper is to state and criticize the most important of these as carefully as I can.

Before entering into these arguments in detail, I would like to point out that this is essentially a question which cannot profitably be discussed by mere philosophers or by mere scientists, but only by persons with a competent knowledge both of philosophy and of natural science. The

question is: are events of a certain kind causally connected with events of a certain other kind, or are they not? To answer such a question one must have a competent knowledge of the two kinds of events and their laws, and one must understand exactly what is meant by causation. Now mental events and their laws are treated by psychology, and bodily events and their laws are treated by mechanics, physics, chemistry, and physiology. Hence some knowledge of all these sciences is necessary before one can discuss this question. But, though it is necessary, it is not sufficient. All natural sciences make constant use of the notion of causation, but the notion of causation does not form part of the subject matter of any natural science. Causation, its precise limitations, are part of the subject matter of philosophy. Similarly arithmetic makes continual use of reasoning but it is not about the process of reasoning, for this is dealt with by logic.

With these preliminary remarks we may turn to the special arguments which have been used against interactionism. I will begin with two purely philosophical arguments. They seem to me quite worthless and we may as well clear them out of the way at once.

I. One argument is that body and mind are so entirely unlike each other that it is inconceivable that events in one should cause events in the other. How could two events so different as eating a beefsteak and thinking of a poem, or having a volition and making a bodily movement be causally connected? This argument assumes that events can only cause each other if they be sufficiently similar, that if they be sufficiently similar their causal connection is intelligible, but if they be very different it is inconceivable. The answer is (*a*) that however similar two events may be the fact that one causes the other is never self-evident but has to be learnt by experience. It is not *a priori* self-evident that one billiard ball moving straight on to

another will make the second move in the same straight line; we have simply learnt that this is what actually happens. We have exactly the same kind of evidence for the view that sticking a pin into a man's body causes a painful sensation in his mind. In neither case is the connection intelligible, if by intelligible you mean logically deducible from what is otherwise known of the nature of billiard balls or of pins respectively. In both cases it is intelligible, if by this you mean that it is a fact which involves no contradiction and is actually found to be true. (*b*) We are not told in this argument how dissimilar events must be before it becomes unintelligible that one should cause the other. A draught is not particularly like a cold in the head, but no one who habitually changes trains at Clapham Junction will deny that the former may cause the latter. And if the dissimilarity between a draught and a cold in the head does not render their causal connection impossible, I fail to see why the difference between a pinprick and a painful sensation should make *their* connection unintelligible.

II. A more refined form of philosophical argument is the following. It is said that wherever we have a genuine instance of causation the events are connected by a great many other relations as well as the causal one. The two billiard balls have definite spatial relations to each other, and so on. It is argued that there are no such relations between a pinprick and a painful sensation or a volition and a bodily movement. The mental states are not in space and the bodily events are, hence there can be no spatial relations between them. Hence it is argued that mental and bodily events cannot be causally connected. Although this argument has the support of so eminent a philosopher as Professor Stout, I must confess that I can see very little in it. I have four objections to it. (*a*) How do we know that the causal relation can only subsist between two events

when other relations subsist between them too? It does not seem self-evident and I know of no attempt to prove it. (*b*) How do we know that there are not other relations between mental and bodily events? It is perfectly conceivable and even probable that bodies have many qualities which we cannot perceive owing to the very limited range of our senses. It is still more likely that states of mind have many properties which we cannot detect by introspection. I see no difficulty whatever in supposing that there may be plenty of relations between states of mind and states of body of which we are unable to become aware. Now, if this possibility be granted, it seems much more reasonable, in view of the strong appearances in favor of interactions and the difficulties which we shall find in all alternative views, to suppose that there really is interaction and that we are unable to become aware of the other relations than that no other relations exist and consequently there is no interaction. (*c*) But, further, in certain cases we can actually see that there are other relations between mental and bodily events. When I will to move my arm I have to think of my arm and of its present and its future positions. Here we have at once a definite relation between volition and bodily movement, viz., the fact that the part of the body to be moved and its movement must be objects of thought to the mind. This is just as good a relation as the spatial relations of the billiard balls. Since mind and body are very different we need not be surprised to find that the relations between mental and bodily events when they interact are considerably different from those between two bodily events when they interact. (*d*) Finally, a man who believes that mind and body interact is not obliged to suppose that a bodily event is ever the total cause of a mental one or conversely. It is quite open to him to think that a painful sensation has a complex cause one part of which is a pinprick and the other some state

of his mind. There is much in our experience to favor such a view and nothing against it. E. g., a person who is kicked with the same hardness, once when he is sitting quietly and at another time when he is playing in a football match, will have considerably different sensations in the two cases. This suggests that the sensation felt is a joint product of his body and his mind. If his body had not been kicked he would not have had the painful sensation, if his mind had not been attending intently to the game the sensation would have been much more painful. But, if states of mind are often the joint products of states of body and of other states of mind, and conversely, the objection that there is no other relation between the alleged cause and the alleged effect obviously breaks down; for there will be an intimate relation between the mental factor in the total effect.

For these reasons I think that the purely philosophical arguments against interaction have no tendency to refute the view of common sense, and therefore we may turn to arguments based on the accurate observations and the accepted laws of natural science.

The most important argument of this kind is based on observations on the energy-changes in the human body and on the physical principle of the conservation of energy. But closely connected with and supporting this argument is one based on the fact that all nervous process is physiologically of the reflex type. I will deal with these two arguments in turn. The one about the conservation of energy will occupy us for some time, for we shall have to make clear (*a*) what are the observed facts, (*b*) what is really meant by the conservation of energy and in what sense it is probably true, and (*c*) what bearing the observed facts and the principle really have on the question of interaction.

a. The following are the observed facts. Very careful experiments have been performed on human beings with a

view to testing whether any changes of energy occur in human bodies which cannot be accounted for by the chemical energy produced by the oxidation and other changes in the chemical energy of the food which a man eats. When a man moves his arm there is an increase of kinetic energy. But it is found that, within the limits of experimental error, this increase is compensated for by a decrease in the chemical energy of some part of his body. The upshot of the matter is that competent observers after careful experiments seem to be convinced that the system composed of a human body, the air that it breathes, the food that it eats, and the heat that it evolves is energetically a closed system. That is, it is a system whose total energy remains unchanged, an increase in one factor being compensated by a decrease in some other factor. I do not intend to criticize these observations, which seem to have satisfied competent observers, except on one point. It seems to me that such experiments can only tell us what is true on an average over a long space of time. To make them perfectly satisfactory one would need to know the total chemical energy in the man's body at each moment of the experiments. This we naturally cannot do since it would involve killing the man and analyzing his body at each moment; a process which would be both illegal and physically impossible, since it would involve killing him to get one's observation and bringing him to life again to continue the experiments. Remembering these limitations we can say that the net result is that over the period of the experiment the total amount of energy given out by the body in heat and movement balances that lost by the food eaten and the air breathed. This leaves it perfectly open to us to hold that the balance is not maintained at every moment, that sometimes there is more and sometimes less total energy present in the system, but that these differences average out over a long period and are never very great.

It is doubtless true that we should always find that when less energy was being given out in heat and movement than was being taken in in food and air the weight of the man's body increased. We could thus conclude that chemical products were being stored up in the man's body and might suspect that their chemical energy would make the balance right. But we cannot be sure of this because we cannot kill the man and discover just what these storage products are and hence what their chemical energy is. We cannot therefore be perfectly sure that the total energy of the system never decreases, though we may very strongly suspect this. We are on safer ground in concluding that the total energy of the system never increases. When more energy is given out in heat, movement, and waste products than is being taken in in food we shall find a decrease in weight in the man's body. This will lead us to ascribe the balance to the oxidation of stored products. An analysis of the waste products may then tell us what these stored materials must have been and from this knowledge we can deduce the chemical energy which will be liberated by their oxidation.

The upshot of the matter seems to be that (1) we can be pretty certain that in the long run and on the average the energy given out by the body balances that taken in. (2) That we can be pretty sure that at no moment does the total energy of the system increase. (3) That we may strongly suspect, but can never be quite so certain, that at no moment does the total energy of the system decrease.

b. We have so far spoken of energy as if every one knew what it was, and of the conservation of energy as if this were an unambiguous principle which was certainly true. We must now try to become clear on these two points. The only perfectly clear meaning of energy and its conservation is found in kinetic energy in mechanics and in the collision of perfectly elastic bodies. All other forms of

energy and all statements about their conservation are not matters of pure observation but are a mixture of observation and convention. This I will now try to show.

The kinetic energy of a body of mass m moving with a velocity v is defined as the product $\frac{1}{2}mv^2$. Since mass and velocity can be measured kinetic energy can also be measured. If two perfectly elastic bodies (*e. g.*, two billiard balls) collide it is found that the sum of their kinetic energies before and after impact is practically the same, though the distribution of it between the two may be greatly changed by the collision. Here everything is measurable, the meaning of the law is perfectly clear and there is no element of convention in it. The next stage is the introduction of the notion of potential energy in mechanics. Suppose that a body with kinetic energy $\frac{1}{2}mv^2$ moves up against a perfectly elastic spring and presses it inward. The velocity of the body and hence its kinetic energy will gradually be reduced to nothing. But subsequently the spring will expand again and impart velocity to the body in the opposite direction. And it is found that when the body once more leaves the spring its kinetic energy will again be approximately $\frac{1}{2}mv^2$. These are the actually observable facts. It is clear that, if we confine ourselves to kinetic energy, this has not been conserved. It has in fact passed through all the values between 0 and $\frac{1}{2}mv^2$, and so at all intermediate stages of the transaction the kinetic energy has been less than at the beginning and end. Now the conservation of energy is only maintained by postulating a new kind of energy *ad hoc* and giving such a measure to it as will preserve the principle intact. It is said that as the body loses kinetic energy the spring gains potential energy and conversely. Now potential energy, unlike kinetic energy, cannot be directly measured; we merely ascribe to it such values at any moment as shall keep the principle true. There is therefore an element of "cooking"

or convention in the principle even as applied to such abstract cases as purely mechanical transactions between perfectly elastic bodies. All that we can say is that the assumption of potential energy and the ascription of this value to it are compatible with the observable facts, not that they are necessitated by them.

If now we leave purely mechanical events and purely elastic bodies a further dose of convention is needed to preserve the principle, though there are also further observed facts to take into account. If we used billiard balls of lead or putty we should find that the kinetic energy was nothing like the same after a collision as before. Nor could we put this right by assuming potential energy and giving an appropriate measure to it, for we should find that the bodies, unlike the spring in the last example, had been permanently deformed. And, so long as we keep to mechanics, we must simply say that the principle has broken down beyond hope of further "cooking." But, by extending our observations beyond mechanics, we can discern a further important law of motion; and, by a liberal dose of convention, we can state this law in such a way that the conservation of energy can be retained. We shall find that when bodies are permanently deformed other physical phenomena occur. Their temperature rises, they may give out sound waves, or they may produce electrical phenomena. We can directly measure quantity of heat in its own units. And it has been abundantly proved that when a certain amount of kinetic energy disappears from a system and no other change takes place except a rise in temperature the amount of kinetic energy lost measured in mechanical units and the amount of heat gained measured in thermal units bear a constant relation. The same is true when heat disappears and kinetic energy is the only result. Note that, strictly speaking, there can be no question of equality. Kinetic energy is one thing, heat is another; a unit of

kinetic energy is different from a unit of heat, and it is really meaningless to talk about equality between the two. All the observed facts tell us is that the number which measures one in its units bears a constant relation to the number that measures the other in *its* units. The same is found to hold for other physical phenomena like light, sound, and electricity. Now these observed facts can be stated in the form that quantity of heat, electric potential, etc., are forms of energy and that when ever one disappears from a system an equal quantity of the other takes its place. Quite strictly speaking this is nonsense, because you can no more talk of a quantity of heat being equal or unequal to a quantity of electric potential than of an archdeacon being equal or unequal to a quadratic equation. Equality and inequality, in the strict sense, can only hold between two quantities of the same kind; and a quantity of heat is not of the same kind as a quantity of electric potential. But this way of talking is convenient in practice, and, by adopting it, the form of the conservation of energy can be preserved when it would otherwise break down. We may sum up then as follows: Strictly taken the conservation of energy is a meaningless and nonsensical proposition. But, interpreted liberally, it is a statement of the observed fact that in mechanical, physical, and chemical phenomena, when n units of any one kind disappear from a system there will be an increase in the number of units of some of the other kinds in the system, and the numerical values of these increases will bear a constant ratio to n. It must be added that this will only be true if the system is isolated; otherwise, as when heat leaves a system by radiation, the compensating change may happen in some other system. The law will then hold of the two systems taken together, but not of either taken separately.

c. Now this principle, together with the experimental facts about the energy-changes in the human body de-

scribed above, is taken to prove that the mind does not act on the body and that the body does not act on the mind. The question for us is: Does it prove anything of the sort? I take the argument to be this. Experiment proves that the body, its food, air, etc., form an isolated energetic system. Any change in the energy of the body is completely balanced, in the sense given above, by other changes in the energy of this system. If the mind acted on the body this system could not be isolated, energy would appear in it when we made a voluntary movement, and this energy would not be balanced by the disappearance of energy from any other part of the system. Similarly if the body acted on the mind energy would disappear from the body when the mind had a new sensation, and this energy would not be balanced by an increase somewhere also in the system. As this balance actually does take place mind cannot act on body and body cannot act on mind.

This argument, which has convinced a great many eminent persons of the impossibility of interaction, seems to me to have no weight at all against the evidence from constant experience in favor of interaction. I will now state why it appears to me to be worthless. It assumes that if body and mind interacted with each other we should have to assume a new kind of energy—mental energy—in order to preserve the conservation of energy. We should find energy unaccountably appearing in the body when we made a volition to move and unaccountably disappearing from it when a pin entering our bodies was followed by a sensation in our minds. Since we do not need to assume mental energy it is concluded that there can be no interaction. But this would only follow if it were certain that two things cannot interact without changes of energy in each. Now this is not asserted by the conservation of energy at all. What is asserted is that *if* things interact and *if* their interaction be accompanied by change of energy, then these

changes will obey the conservation of energy. The conservation of energy then by itself has no bearing on the question of interaction. It is true however that when physical systems interact with each other there are changes of energy in both; though this could not have been foretold from the conservation of energy. But this does not in the least prove that *all* interaction must be accompanied by changes of energy; in particular it leaves it a perfectly open question whether, when a mind interacts with a body, such changes take place. The experimental facts strongly suggest, though they do not prove, that the interaction of mind and body is not accompanied by changes of energy; they have not the faintest tendency to show that no interaction takes place. And the conservation of energy, which is apparently supposed to be the bulwark of this argument, turns out to have as little to do with the case as "the flowers that bloom in the spring."

On the same experiments and the same physical principle another argument is often based. It is said that the experiments prove that the body and its surroundings obey the conservation of energy and that it follows from this fact that everything would proceed in exactly the same way in the body if it had no mind and in the mind if it were not connected with a body. The results of this suggestion are so startling that it may be worth while to consider them for a moment before dealing with the validity of the argument. The L. N. W. Railway was ultimately built entirely by the bodily movements of human beings, and the trains run at stated times from the same causes. If these bodily movements were to take place just the same apart from minds we should have to believe that, although there had never been the faintest glimmer of intelligence on the earth, the L. N. W. Railway would still have been built and that trains would still run into and out of Euston driven by mindless engine drivers and containing mindless passen-

gers reading newspapers printed by mindless printers. Now it really seems incredible that all these things should go on as before if there had been no minds; we should surely expect to find an immense and noticeable difference in everything (except possibly the newspapers). Similarly if the body never acts on the mind we must believe that all our mental states are caused by other mental states. There could be no question of getting a new idea from reading a book or a new sensation from sitting on a tintack, for books and tintacks are alike physical objects. And if we resolutely reject the obvious physical causes of such new sensations and ideas we can find no trace of any mental cause in our past history for them. Any argument which leads to such extraordinary conclusions as this will need to be very strong indeed before it can be reasonable to accept it. In actual fact the argument is extremely weak. Since *every* physical system obeys the conservation of energy the mere knowledge that some particular system such as the human body obeys it will not tell us what that system in particular will do. The system composed of a gun, a bullet, and an explosive obeys the conservation of energy; when it is not discharged the bullet and gun have no kinetic energy and the explosive has great chemical energy, when it is discharged the kinetic energy gained by the bullet and gun is balanced by the chemical energy lost by the explosive. But this knowledge does not suffice to tell us either that the gun will be discharged, or, if so, when it will be discharged. It does not even tell us in what proportion the kinetic energy will be divided between the gun, the bullet, and the gases evolved when the gun is discharged. Similarly the mere knowledge that the human body obeys the conservation of energy does not tell us that it will do anything at all, nor does it tell us what it will do and when it will do it if it does anything. Once again then an argument against interaction which professes to be based on

the conservation of energy and on the experiments that have been made on the energy-changes in human bodies is found to rest on neither. What does this argument really involve then? We find in all purely physical and chemical systems, i. e., non-living material systems, that, although the conservation of energy does not determine whether or when one kind of energy will disappear and another kind appear, yet these transformations do obey definite laws. Thus the gun goes off when the temperature is sufficiently and suddenly raised or when a shock is administered to the explosive. We may then define a purely physico-chemical system as one which obeys the conservation of energy, and in which, further, the transformations of energy which take place and the times when they take place are determined by purely material causes according to the special laws of physics and chemistry. Now if the human body were such a material system as this it would follow that the mind could not act on the body, though it would not follow that the body could not act on the mind. A purely physico-chemical system is defined as one where the only causes of change are material ones acting in accordance with physico-chemical laws. If the only causes be material it is clear that none of them could be mental, and that the mind could not act on the body. On the other hand, even if all the transformations of energy in the human body were determined physically or chemically it would not follow that they might not also cause changes in the mind. It is true that physical and chemical changes do not cause sensations when they occur in non-living bodies, but that may perfectly well be because such bodies do not have any minds attached to them in which sensations could be caused. It may quite well be a law of nature as invariable as any of the laws of physics and chemistry that all material systems of the form and complexity of living bodies are accompanied by minds; and that, although the changes in

these systems take place entirely in accordance with the laws of physics and chemistry, yet certain of them also cause changes in the minds which, by an invariable law of nature, are attached to such material systems. Nothing that we know about the experimental facts or the laws of physics and chemistry precludes this possibility, and our knowledge that certain bodily changes are always followed by certain sensations and that no other cause for these sensations can be plausibly suggested makes the possibility highly likely. We may call the view that body acts on mind but mind does not act on body "one-sided interactionism." We see then that if it can be proved that all bodily changes take place entirely through chemical and physical causes the most reasonable view to take of the relation between mind and body will be that of one-sided interactionism.

For some reason one-sided interactionism is always stated in a peculiarly absurd form by philosophers and scientists, and is then easily refuted. It is nearly always identified with what is called "epiphenomenalism." This is the doctrine that mental states have no effect either on the body or on each other, that each is produced separately by some bodily change and makes no further difference to anything either mental or bodily. Now if this were the only form that one-sided interaction could take it might fairly be regarded as a preposterous theory. But there is not the least reason either in logic or in any known facts why one-sided interactionism should take the form of epiphenomenalism. It is perfectly open to us to hold that the mind does not act on the body but that mental states are a joint product of certain bodily processes and of past mental states. And there is no reason whatever why certain mental states should not have purely mental causes.

We have now seen what are the consequences of the hypothesis that all changes in the human body take place

in accordance with purely physico-chemical laws and have purely material causes. We must now ask whether there is any reason to suppose that this hypothesis is true. First we must notice that, since this conclusion does not follow from the conservation of energy, the evidence for the truth of that law in general, and the experiments which tend to show that the human body and its surroundings form a closed energetic system, have no bearing whatever on the question whether the human body is a purely physico-chemical system. Secondly we must notice that it might be true that the human body is not a purely physico-chemical system, and yet that the vast majority of the processes in it proceed in accordance with purely physico-chemical laws.

If the mind acts on the body at all it is pretty certain that it does not as a rule act directly on most parts of the body. If it acts on the body at all it acts presumably on certain parts of the brain and determines when and to what extent a transformation of energy shall occur there. All the subsequent consequences of this transformation in all the other parts of the body might proceed in accordance with purely physico-chemical laws, and of course all the bodily changes whether started mentally or materially might obey the conservation of energy. It follows that even if all physiologists were agreed (as I understand they are not) in holding that every bodily process that they had investigated took place in accordance with physico-chemical laws it would not in the least follow that none of these processes are started in the brain by the action of the mind.

When we remember the extreme difficulty of proving a negative about any thing, the extreme complexity of the human body, and the impossibility of accurately determining the details of minute processes in the brain of living beings, we may fairly assert that there is no prospect whatever of a direct experimental proof that every process in a living human body proceeds from beginning to end from

purely material causes and in accordance with purely physico-chemical laws. Now when a hypothesis cannot be proved or refuted by direct experiment our only course is to consider what will follow if it is true. No hypothesis can be more probable than its logical consequences; hence, if the logical consequences of a hypothesis be wildly improbable we must conclude that the hypothesis is itself wildly improbable. Now the logical consequence of the hypothesis that the body is a purely physico-chemical system is that all its actions would be precisely the same whether it were accompanied by a mind or not. We have already seen that, when this suggestion is considered in detail, it is so wildly improbable as to be ludicrous. Hence I conclude that the view that the human body is a purely physico-chemical system is preposterous, and therefore that there is no reason to suppose that the mind does not act from time to time on the body.

I cannot however leave this point without saying something about the "enlightened parallelist" who figures in Chapter III, § 6, of Professor Stout's *Manual of Psychology* (third edition). Stout, who himself inclines to accept the arguments against interaction, admits that if the denial of interaction led to such absurd results as we have indicated, he would be forced to reject parallelism. But he thinks that they need not lead to any such absurdities. I will quote his example of the enlightened parallelist's treatment of the writing of *Hamlet*. "The manuscript may be regarded from two points of view, each taking account of only one aspect of its nature. In the first place, it may be regarded merely as one portion of matter among others.... From this point of view its existence can be accounted for through merely material conditions including especially certain occurrences in.... Shakespeare's brain. But the manuscript is not merely a material thing; it is also the manuscript of a play to be read, acted, and criticized. From

this point of view explanation in terms of material conditions certainly breaks down. What is essential here is the mind, not the brain, of Shakespeare; what is essential is Shakespeare as a subject, thinking, feeling, willing and adapting means to ends.... Whether we adhere to.... parallelism or to.... interaction, this teleological point of view remains unaffected."

The weakness of this passage is that it starts by professing to tell us how the enlightened parallelist will "account for the production of the manuscript of *Hamlet*." But it actually tells us nothing of the kind. It tells us what any enlightened person must recognize as the distinctive peculiarity of such material objects as manuscripts (viz., that they have a meaning and design). It does not in the least tell us how the enlightened parallelist can account, *qua* parallelist, for what he has to admit, *qua* enlightened.

But we may go further than this. Does Professor Stout mean that Shakespeare's brain and other material causes brought about the particular collection of marks on paper which constitute the manuscript of Hamlet, and that Shakespeare's mind caused the meaning of this collection of marks without affecting his body? Let us consider in what sense you can be said to cause the meaning of a set of marks. Unless a man is making up for himself a new language or symbolism there seems to be only one sense in which he can cause the meaning of a collection of marks. And the sense is this. Certain collections have, independently of him, a meaning for those who see them; and others do not. Of the former, some have, independently again of him, one meaning; and some have another. The only way in which he can cause a meaning is by causing the particular collection of marks that have that meaning. The only way in which he can do this is by the appropriate use of his body. And the only way in which he can appropriately use his body for this purpose is through his

mind thinking of the meaning and causing his body to make the movements which cause the collection of marks that express this meaning. Unless the thoughts and desires of the mind can affect the movements of the body I fail altogether to see how an intentional meaning can be expressed by any material object which is produced by the movements of the body.

So far as I can see the least that an enlightened parallelist could hold would be somewhat as follows: (1) All material systems and their changes have purely material causes. (2) Of material systems some are marked off from the rest by showing traces of meaning or design. (3) Somewhere among the material causes of such peculiar material systems will be a state or states of some one's brain. (4) With this state or these states will always be correlated in some one's mind a thought of the meaning and a desire for its expression.

Such a view seems possible, even if not plausible. But it would still leave parallelism powerless to explain the causes of our sensations. I think therefore that one-sided interaction of body or mind would always be in a stronger position than parallelism. For (*a*) it can give the usual explanation of the causes of our sensations. (*b*) It is, as we have seen, perfectly compatible even with the view that the body is a purely physico-chemical system. (*c*) With regard to the causation of material objects which show traces of meaning or design it could take practically the same view as I have ascribed to a really enlightened parallelist. The only modification would be that for (4) in the enlightened parallelist's position it would substitute the proposition: This state or these states of brain *cause* in the mind connected with this brain a thought of the meaning and a desire for its expression.

Mr. Russell argues in his *Lowell Lectures* that when we once understand that causation is nothing but functional

correlation we can see that the quarrel between an interactionist and an enlightened parallelist is largely a matter of words. On this assumption as to the meaning of causation it will at any rate follow that if parallelism be true so is interactionism. If we hold that there is a one-to-one correlation between the states of our brain and the states of our minds, and a one-to-one correlation between the states of our brains and the changes in the physical world which we say that these produce, then there will be a one-to-one correlation between our states of mind and the changes in the physical world. And if causation means nothing but such correlation then we have as much right to say that our states of mind cause the changes in the physical world as that our states of brain do so, or that our states of mind cause our states of brain and that these cause the changes in the physical world.

But, in the first place, I am very doubtful whether functional correlation be the whole of what we mean by causation. This, however, is not the place to embark on this wide inquiry. Secondly, even on Russell's theory of causation, interaction would not imply parallelism. E. g., there might be two bodily states which, as such, were indistinguishable in their qualities. To one there might be correlated a state of mind and to the other no state of mind. Now if we found that the first was correlated with a different kind of change in physical objects from that which is correlated with the second we could say that the state of mind is an essential part of the cause of changes of the first kind. Hence the question at issue between parallelists and interactionists will still be a real one.

It remains to notice a second scientific argument, drawn from the constitution of the nervous system, which is supposed to prove or render it probable that all bodily processes are purely physico-chemical, and hence that mind and body do not interact. If you take a purely reflex action, which

may go on without consciousness, the arrangement of the part of the nervous system involved is that the afferent nerves convey the stimulus from the surface of the body and are connected with efferent nerves which convey a corresponding stimulus to the muscles. The two nerves join, or at least come into very close contact, at some place called a *synapsis*; and it looks as if the whole process consisted in some physical or chemical change being started by the external stimulus, pushing along the afferent nerve, affecting the efferent nerve through the synapsis, and producing in it a physical or chemical change which travels along this to a muscle and causes it to contract. There is no stage in such a process when it is necessary or reasonable to invoke anything but physical or chemical causes and laws. Now, it is said, all the nervous mechanism of the body, whether it be associated with mere reflex action or with apparent control of acts by consciousness is of the same type as the reflex arc. It simply consists of an enormous complication of such arcs, so that when a process of change once starts to travel along an afferent nerve there is an immense variety of different possible efferent nerves along which it may travel back to the surface of the body. Hence a single stimulus may be followed by an immense variety of external actions on different occasions. But, it is argued, we do not here have anything qualitatively different from the simple reflex arc, the only difference is one of complication. Hence if we did not need to assume anything but physico-chemical causes at any stage in a simple reflex action there can be no need to assume anything else in the most complex voluntary action. The different actions that follow at different times from the same stimulus will depend on the different resistance at different times of the various *synapses*; but there is no reason to suppose that these variations in resistance are due to aught but physico-chemical causes. If mind and

body really interacted, it is said, we should expect to find that certain afferent nerves ended in a kind of blank space in the brain and certain efferent nerves started from the same space. Then we might suppose that a stimulus reaching one end of an afferent nerve would affect the mind and that the mind by its voluntary decision would affect the end of an efferent nerve and thus start a nervous current down it which would finally cause a voluntary movement. Now we do not find any such arrangement as this in the nervous system; hence, it is argued, we may conclude that the mind does not intervene at any stage of the process.

It seems to me that, of these two arguments, which generally appear together, the second is quite worthless, while the first does indeed prove something, though not what its employers suppose it to prove. I call the second worthless because it practically assumes that, if at any point there is a gap in a process of purely physical causation, then must there be a spatial discontinuity, and the mind, in order to act, must somehow be in this gap as a wire has to fill up the gap between a bell-handle and a bell if the former is to ring the latter. Now this assumption simply rests on lack of imagination and abuse of spatial metaphors. When we say that somewhere in a process there is a gap in purely physico-chemical causation we simply mean that at some stage of the process an event occurs which cannot be explained by purely physico-chemical laws. It is obviously unnecessary to suppose that at this stage there must also be a gap or breach of spatial continuity in the process. So far the argument consists in confusing two senses of gap (i) a gap in an explanation, (ii) a gap in space. You must just as well argue that only persons over six feet in height can have high moral characters.

The other confusion consists in supposing that if a mind acts on things in space it must itself occupy a particular

portion of space. That is simply due to lack of imagination. We are most accustomed to deal with the actions of things which have definite shapes, sizes, and positions; hence we are inclined to think that all things that act must have these characteristics. The inhabitants of Central Africa had just as good reasons for supposing that all men are black.

The first argument, on the other hand, does, I think, strongly suggest what kind of action the mind has on the body, but does not suggest that it has none at all. It strongly suggests that when the mind acts on the body what it does is to raise the resistance of some *synapses* and lower the resistance of others. It is probable that the resistance of *synapses* has causes which are partly physico-chemical and partly mental, that they may get into a state in which the mind cannot affect them, and that very often the mind does not affect them even though it could. In purely reflex actions it is possible that the mind has no control; in habitual actions which we can control but do not as a rule trouble to control, the non-physical cause is in abeyance; in habitual actions which have got beyond the control of the will the mind has lost its power of interfering with the chemico-physical process. This much the facts about the nervous system do render highly probable. That they do not render it probable that the mind has no control in any case seems to me to result from the following considerations.

The argument that the whole of our nervous processes are of the same type as those which accompany purely reflex actions cuts both ways. Whatever be the similarity in the nervous mechanism it cannot be denied that there is a clear introspective difference between the experience of a purely reflex act, like blinking when something approaches our eye or sneezing when we smell pepper, and a voluntary act, like deciding with difficulty to get out of a warm bath on a cold day. This is a real difference open to any one's inspection. Moreover it is a *qualitative* difference and not

a merely quantitative one; the experience of voluntary decision is not simply a mass of experiences of reflex action. Now this qualitative distinction has to be explained somehow; and the more you insist that the whole nervous system differs only quantitatively by its greater complexity from the simple reflex arc the more difficult it becomes to explain the admitted qualitative difference in the two experiences. If then it be certain that the structure of all parts of the nervous system differs only quantitatively from that of the part which is associated with reflex action we seem forced to suppose that there must be some difference, not of structure but of process, in the part associated with voluntary action. And in view of the evidence from daily life that the mind does act on the body in volition it seems reasonable to suppose that this difference consists in the fact that certain processes in the higher nervous system are not entirely physico-chemical. The facts, then, so far from proving that the body is a purely physico-chemical system and that the mind cannot act on it, rather tend in the opposite direction.

We may now sum up our results. (1) The most probable theory is that the mind sometimes acts on the body and the body sometimes acts on the mind. We have evidence for this of the same kind and the same amount as for any other case of causation. None of the objections to it are anything like conclusive, and all alternative theories lead to wildly improbable conclusions. (2) It is probable that in acting on the body the mind does not alter the total energy of the body but only determines in certain cases when and to what extent it shall be transformed. (3) It is probable that in voluntary action the mind affects the body by modifying the resistance of certain synapses. (4) The view that the body is a purely physico-chemical system does not follow from the conservation of energy, and can neither be proved nor disproved by direct experi-

ment. If it were true it would still be possible and reasonable to hold that the body can act on the mind. The reason for thinking that it is not true is that it leads to the conclusion that the body would behave in precisely the same way if it had no mind connected with it, and that this seems most improbable. (5) The arguments based on the structure of the nervous system are partly mere confusions and prejudices. They have no tendency to show that the mind cannot act on the body; but, when all the facts are taken into account, they tend to make it probable that the mind does act on the body. (6) The most foolish of all theories as to the relation of body and minds seems to be epiphenomenalism; next to it comes parallelism, the doctrine that all which goes on in the body is determined by purely bodily causes, that all that goes on in the mind is determined by purely mental causes, and yet that there is a mysterious correlation between events in one series and events in the other.

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