

## Lecture IV. Influence of Past History on Present Occurrences in Living Organisms

In this lecture we shall be concerned with a very general characteristic which broadly, though not absolutely, distinguishes the behaviour of living organisms from that of dead matter. The characteristic in question is this:

The response of an organism to a given stimulus is very often dependent upon the past history of the organism, and not merely upon the stimulus and the HITHERTO DISCOVERABLE present state of the organism.

This characteristic is embodied in the saying "a burnt child fears the fire." The burn may have left no visible traces, yet it modifies the reaction of the child in the presence of fire. It is customary to assume that, in such cases, the past operates by modifying the structure of the brain, not directly. I have no wish to suggest that this hypothesis is false; I wish only to point out that it is a hypothesis. At the end of the present lecture I shall examine the grounds in its favour. If we confine ourselves to facts which have been actually observed, we must say that past occurrences, in addition to the present stimulus and the present ascertainable condition of the organism, enter into the causation of the response.

The characteristic is not wholly confined to living organisms. For example, magnetized steel looks just like steel which has not been magnetized, but its behaviour is in some ways different. In the case of dead matter, however, such phenomena are less frequent and important than in the case of living organisms, and it is far less difficult to invent satisfactory hypotheses as to the microscopic changes of structure which mediate between the past occurrence and the present changed response. In the case of living organisms, practically everything that is distinctive both of their physical and of their mental behaviour is bound up with this persistent influence of the past. Further, speaking broadly, the change in response is usually of a kind that is biologically advantageous to the organism.

Following a suggestion derived from Semon ("Die Mneme," Leipzig,

1904; 2nd edition, 1908, English translation, Allen & Unwin,

1921; "Die mnemischen Empfindungen," Leipzig, 1909), we will give the name of "mnemic phenomena" to those responses of an organism which, so far as hitherto observed facts are concerned, can only be brought under causal laws by including past occurrences in the history of the organism as part of the causes of the present response. I do not mean merely--what would always be the case--that past occurrences are part of a CHAIN of causes leading to the present event. I mean that, in attempting to state the PROXIMATE cause of the present event, some past event or events must be included, unless we take refuge in hypothetical modifications of brain structure.) For example: you smell peat-smoke, and you recall some occasion when you smelt it before. The cause of your recollection, so far as hitherto observable phenomena are concerned, consists both of the peat smoke

(present stimulus) and of the former occasion (past experience). The same stimulus will not produce the same recollection in another man who did not share your former experience, although the former experience left no OBSERVABLE traces in the structure of the brain. According to the maxim "same cause, same effect," we cannot therefore regard the peat-smoke alone as the cause of your recollection, since it does not have the same effect in other cases. The cause of your recollection must be both the peat-smoke and the past occurrence. Accordingly your recollection is an instance of what we are calling "mnemic phenomena."

Before going further, it will be well to give illustrations of different classes of mnemic phenomena.

(a) ACQUIRED HABITS.--In Lecture II we saw how animals can learn by experience how to get out of cages or mazes, or perform other actions which are useful to them but not provided for by their instincts alone. A cat which is put into a cage of which it has had experience behaves differently from the way in which it behaved at first. We can easily invent hypotheses, which are quite likely to be true, as to connections in the brain caused by past experience, and themselves causing the different response. But the observable fact is that the stimulus of being in the cage produces differing results with repetition, and that the ascertainable cause of the cat's behaviour is not merely the cage and its own ascertainable organization, but also its past history in regard to the cage. From our present point of view, the matter is independent of the question whether the cat's behaviour is due to some mental fact called "knowledge," or displays a merely bodily habit. Our habitual knowledge is not always in our minds, but is called up by the appropriate stimuli. If we are asked "What is the capital of France?" we answer "Paris," because of past experience; the past experience is as essential as the present question in the causation of our response. Thus all our habitual knowledge consists of acquired habits, and comes under the head of mnemic phenomena.

(b) IMAGES.--I shall have much to say about images in a later lecture; for the present I am merely concerned with them in so far as they are "copies" of past sensations. When you hear New York spoken of, some image probably comes into your mind, either of the place itself (if you have been there), or of some picture of it (if you have not). The image is due to your past experience, as well as to the present stimulus of the words "New York." Similarly, the images you have in dreams are all dependent upon your past experience, as well as upon the present stimulus to dreaming. It is generally believed that all images, in their simpler parts, are copies of sensations; if so, their mnemic character is evident. This is important, not only on its own account, but also because, as we shall see later, images play an essential part in what is called "thinking."

(c) ASSOCIATION.--The broad fact of association, on the mental side, is that when we experience something which we have experienced before, it tends to call up the context of the former experience. The smell of peat-smoke recalling a former scene is an instance which we discussed a

moment ago. This is obviously a mnemonic phenomenon. There is also a more purely physical association, which is indistinguishable from physical habit. This is the kind studied by Mr. Thorndike in animals, where a certain stimulus is associated with a certain act. This is the sort which is taught to soldiers in drilling, for example. In such a case there need not be anything mental, but merely a habit of the body. There is no essential distinction between association and habit, and the observations which we made concerning habit as a mnemonic phenomenon are equally applicable to association.

(d) NON-SENSATIONAL ELEMENTS IN PERCEPTION.--When we perceive any object of a familiar kind, much of what appears subjectively to be immediately given is really derived from past experience. When we see an object, say a penny, we seem to be aware of its "real" shape we have the impression of something circular, not of something elliptical. In learning to draw, it is necessary to acquire the art of representing things according to the sensation, not according to the perception. And the visual appearance is filled out with feeling of what the object would be like to touch, and so on. This filling out and supplying of the "real" shape and so on consists of the most usual correlates of the sensational core in our perception. It may happen that, in the particular case, the real correlates are unusual; for example, if what we are seeing is a carpet made to look like tiles. If so, the non-sensational part of our perception will be illusory, i.e. it will supply qualities which the object in question does not in fact have. But as a rule objects do have the qualities added by perception, which is to be expected, since experience of what is usual is the cause of the addition. If our experience had been different, we should not fill out sensation in the same way, except in so far as the filling out is instinctive, not acquired. It would seem that, in man, all that makes up space perception, including the correlation of sight and touch and so on, is almost entirely acquired. In that case there is a large mnemonic element in all the common perceptions by means of which we handle common objects. And, to take another kind of instance, imagine what our astonishment would be if we were to hear a cat bark or a dog mew. This emotion would be dependent upon past experience, and would therefore be a mnemonic phenomenon according to the definition.

(e) MEMORY AS KNOWLEDGE.--The kind of memory of which I am now speaking is definite knowledge of some past event in one's own experience. From time to time we remember things that have happened to us, because something in the present reminds us of them. Exactly the same present fact would not call up the same memory if our past experience had been different. Thus our remembering is caused by--

- (1) The present stimulus,
- (2) The past occurrence.

It is therefore a mnemonic phenomenon according to our definition. A definition of "mnemonic phenomena" which did not include memory would, of course, be a bad one. The point of the definition is not that it includes memory, but that it includes it as one of a class of phenomena which embrace all that is characteristic in the subject matter of psychology.

(f) EXPERIENCE.--The word "experience" is often used very vaguely. James, as we saw, uses it to cover the whole primal stuff of the world, but this usage seems objectionable, since, in a purely physical world, things would happen without there being any experience. It is only mnemonic phenomena that embody experience. We may say that an animal "experiences" an occurrence when this occurrence modifies the animal's subsequent behaviour, i.e. when it is the mnemonic portion of the cause of future occurrences in the animal's life. The burnt child that fears the fire has "experienced" the fire, whereas a stick that has been thrown on and taken off again has not "experienced" anything, since it offers no more resistance than before to being thrown on. The essence of "experience" is the modification of behaviour produced by what is experienced. We might, in fact, define one chain of experience, or one biography, as a series of occurrences linked by mnemonic causation. I think it is this characteristic, more than any other, that distinguishes sciences dealing with living organisms from physics.

The best writer on mnemonic phenomena known to me is Richard Semon, the fundamental part of whose theory I shall endeavour to summarize before going further:

When an organism, either animal or plant, is subjected to a stimulus, producing in it some state of excitement, the removal of the stimulus allows it to return to a condition of equilibrium. But the new state of equilibrium is different from the old, as may be seen by the changed capacity for reaction. The state of equilibrium before the stimulus may be called the "primary indifference-state"; that after the cessation of the stimulus, the "secondary indifference-state." We define the "engraphic effect" of a stimulus as the effect in making a difference between the primary and secondary indifference-states, and this difference itself we define as the "engram" due to the stimulus. "Mnemonic phenomena" are defined as those due to engrams; in animals, they are specially associated with the nervous system, but not exclusively, even in man.

When two stimuli occur together, one of them, occurring afterwards, may call out the reaction for the other also. We call this an "ekphoric influence," and stimuli having this character are called "ekphoric stimuli." In such a case we call the engrams of the two stimuli "associated." All simultaneously generated engrams are associated; there is also association of successively aroused engrams, though this is reducible to simultaneous association. In fact, it is not an isolated stimulus that leaves an engram, but the totality of the stimuli at any moment; consequently any portion of this totality tends, if it recurs, to arouse the whole reaction which was aroused before. Semon holds that engrams can be inherited, and that an animal's innate habits may be due to the experience of its ancestors; on this subject he refers to Samuel Butler.

Semon formulates two "mnemonic principles." The first, or "Law of Engrapy," is as follows: "All simultaneous excitements in an organism form a connected simultaneous excitement-complex, which as such works engraphically, i.e. leaves behind a connected engram-complex, which in so far forms a whole" ("Die mnemischen Empfindungen," p. 146). The second mnemonic principle, or "Law of Ekphory," is as follows: "The partial return of the energetic situation which formerly worked engraphically operates ekphorically on a simultaneous engram-complex" (ib., p. 173). These two laws together represent in part a hypothesis (the engram), and in part an observable fact. The observable fact is that, when a certain complex of stimuli has originally caused a certain complex of reactions, the recurrence of part of the stimuli tends to cause the recurrence of the whole of the reactions.

Semon's applications of his fundamental ideas in various directions are interesting and ingenious. Some of them will concern us later, but for the present it is the fundamental character of mnemonic phenomena that is in question.

Concerning the nature of an engram, Semon confesses that at present it is impossible to say more than that it must consist in some material alteration in the body of the organism ("Die mnemischen Empfindungen," p. 376). It is, in fact, hypothetical, invoked for theoretical uses, and not an outcome of direct observation. No doubt physiology, especially the disturbances of memory through lesions in the brain, affords grounds for this hypothesis; nevertheless it does remain a hypothesis, the validity of which will be discussed at the end of this lecture.

I am inclined to think that, in the present state of our knowledge, it affords a simplification, and enables us to state laws of behaviour in less hypothetical terms than we should otherwise have to employ.

The clearest instance of what I mean is recollection of a past event. What we observe is that certain present stimuli lead us to recollect certain occurrences, but that at times when we are not recollecting them, there is nothing discoverable in our minds that could be called memory of them. Memories, as mental facts, arise from time to time, but do not, so far as we can see, exist in any shape while they are "latent." In fact, when we say that they are "latent," we mean merely that they will exist under certain circumstances. If, then, there is to be some standing difference between the person who can remember a certain fact and the person who cannot, that standing difference must be, not in anything mental, but in the brain. It is quite probable that there is such a difference in the brain, but its nature is unknown and it remains hypothetical. Everything that has, so far, been made matter of observation as regards this question can be put together in the statement: When a certain complex of sensations has occurred to a man, the recurrence of part of the complex tends to arouse the recollection of the whole. In like manner, we can collect all mnemonic phenomena in living organisms under a single law, which contains what is hitherto verifiable in Semon's two laws. This single law is:

IF A COMPLEX STIMULUS A HAS CAUSED A COMPLEX REACTION B IN AN ORGANISM, THE OCCURRENCE OF A PART OF A ON A FUTURE OCCASION TENDS TO CAUSE THE WHOLE REACTION B.

This law would need to be supplemented by some account of the influence of frequency, and so on; but it seems to contain the essential characteristic of mnemonic phenomena, without admixture of anything hypothetical.

Whenever the effect resulting from a stimulus to an organism differs according to the past history of the organism, without our being able actually to detect any relevant difference in its present structure, we will speak of "mnemonic causation," provided we can discover laws embodying the influence of the past. In ordinary physical causation, as it appears to common sense, we have approximate uniformities of sequence, such as "lightning is followed by thunder," "drunkenness is followed by headache," and so on. None of these sequences are theoretically invariable, since something may intervene to disturb them. In order to obtain invariable physical laws, we have to proceed to differential equations, showing the direction of change at each moment, not the integral change after a finite interval, however short. But for the purposes of daily life many sequences are to all intents and purposes invariable. With the behaviour of human beings, however, this is by no means the case. If you say to an Englishman, "You have a smut on your nose," he will proceed to remove it, but there will be no such effect if you say the same thing to a Frenchman who knows no English. The effect of words upon the hearer is a mnemonic phenomena, since it depends upon the past experience which gave him understanding of the words. If there are to be purely psychological causal laws, taking no account of the brain and the rest of the body, they will have to be of the form, not "X now causes Y now," but--

"A, B, C, . . . in the past, together with X now, cause Y now." For it cannot be successfully maintained that our understanding of a word, for example, is an actual existent content of the mind at times when we are not thinking of the word. It is merely what may be called a "disposition," i.e. it is capable of being aroused whenever we hear the word or happen to think of it. A "disposition" is not something actual, but merely the mnemonic portion of a mnemonic causal law.

In such a law as "A, B, C, . . . in the past, together with X now, cause Y now," we will call A, B, C, . . . the mnemonic cause, X the occasion or stimulus, and Y the reaction. All cases in which experience influences behaviour are instances of mnemonic causation.

Believers in psycho-physical parallelism hold that psychology can theoretically be freed entirely from all dependence on physiology or physics. That is to say, they believe that every psychical event has a psychical cause and a physical concomitant. If there is to be parallelism, it is easy to prove by mathematical logic that the causation in physical and psychical matters must be of the same sort, and it is impossible that mnemonic causation should exist in psychology but not in physics. But if psychology is to be independent of physiology, and if physiology can be reduced to physics, it would seem that mnemonic causation is essential in psychology. Otherwise we shall be compelled to believe that all our knowledge, all our store of images and memories, all our mental habits, are at all times existing in some latent mental form, and are not merely aroused by the stimuli which lead to their display. This is a very difficult hypothesis. It seems to me that if, as a matter of method rather than metaphysics, we desire to obtain as much independence for psychology as is practically feasible, we shall do better to accept mnemonic causation in psychology *protem*, and therefore reject parallelism, since there is no good ground for admitting mnemonic causation in physics.

It is perhaps worth while to observe that mnemonic causation is what led Bergson to deny that there is causation, at all in the psychical sphere. He points out, very truly, that the same stimulus, repeated, does not have the same consequences, and he argues that this is contrary to the maxim, "same cause, same effect." It is only necessary, however, to take account of past occurrences and include them with the cause, in order to re-establish the maxim, and the possibility of psychological causal laws. The metaphysical conception of a cause lingers in our manner of viewing causal laws: we want to be able to FEEL a connection between cause and effect, and to be able to imagine the cause as "operating." This makes us unwilling to regard causal laws as MERELY observed uniformities of sequence; yet that is all that science has to offer. To ask why such-and-such a kind of sequence occurs is either to ask a meaningless question, or to demand some more general kind of sequence which includes the one in question. The widest empirical laws of sequence known at any time can only be "explained" in the sense of being subsumed by later discoveries under wider laws; but these wider laws, until they in turn are subsumed, will remain brute facts, resting solely upon observation, not upon some supposed inherent rationality.

There is therefore no a priori objection to a causal law in which part of the cause has ceased to exist. To argue against such a law on the ground that what is past cannot operate now, is to introduce the old metaphysical notion of cause, for which science can find no place. The only reason that could be validly alleged against mnemonic causation would be that, in fact, all the phenomena can be explained without it. They are explained without it by Semon's "engram," or by any theory which regards the results of experience as embodied in modifications of the brain and nerves. But they are not explained, unless with extreme artificiality, by any theory which regards the latent effects of experience as psychical rather than physical. Those who desire to make psychology as far as possible independent of physiology would do well, it seems to me, if they adopted mnemonic causation. For my part, however, I have no such desire, and I shall therefore endeavour to state the grounds which occur to me in favour of some such view as that of the "engram."

One of the first points to be urged is that mnemonic phenomena are just as much to be found in physiology as in psychology. They are even to be found in plants, as Sir Francis Darwin pointed out

(cf. Semon, "Die Mneme," 2nd edition, p. 28 n.). Habit is a characteristic of the body at least as much as of the mind. We should, therefore, be compelled to allow the intrusion of mnemonic causation, if admitted at all, into non-psychological regions, which ought, one feels, to be subject only to causation of the ordinary physical sort. The fact is that a great deal of what, at first sight, distinguishes psychology from physics is found, on examination, to be common to psychology and physiology; this whole question of the influence of experience is a case in point. Now it is possible, of course, to take the view advocated by Professor J. S. Haldane, who contends that physiology is not theoretically reducible to physics and chemistry.\* But the weight of opinion among physiologists appears to be against him on this point; and we ought certainly to require very strong evidence before admitting any such breach of continuity as between living and dead matter. The argument from the existence of mnemonic phenomena in physiology must therefore be allowed a certain weight against the hypothesis that mnemonic causation is ultimate.

\* See his "The New Physiology and Other Addresses," Griffin,

1919, also the symposium, "Are Physical, Biological and Psychological Categories Irreducible?" in "Life and Finite Individuality," edited for the Aristotelian Society, with an Introduction. By H. Wildon Carr, Williams & Norgate, 1918.

The argument from the connection of brain-lesions with loss of memory is not so strong as it looks, though it has also, some weight. What we know is that memory, and mnemonic phenomena generally, can be disturbed or destroyed by changes in the brain. This certainly proves that the brain plays an essential part in the causation of memory, but does not prove that a certain state of the brain is, by itself, a sufficient condition for the existence of memory. Yet it is this last that has to be proved. The theory of the engram, or any similar theory, has to maintain that, given a body and brain in a suitable state, a man will have a certain memory, without the need of any further conditions. What is known, however, is only that he will not have memories if his body and brain are not in a suitable state. That is to say, the appropriate state of body and brain is proved to be necessary for memory, but not to be sufficient. So far, therefore, as our definite knowledge goes, memory may require for its causation a past occurrence as well as a certain present state of the brain.

In order to prove conclusively that mnemonic phenomena arise whenever certain physiological conditions are fulfilled, we ought to be able actually to see differences between the brain of a man who speaks English and that of a man who speaks French, between the brain of a man who has seen New York and can recall it, and that of a man who has never seen that city. It may be that the time will come when this will be possible, but at present we are very far removed from it. At present, there is, so far as I am aware, no good evidence that every difference between the knowledge possessed by A and that possessed by B is paralleled by some difference in their brains. We may believe that this is the case, but if we do, our belief is based upon analogies and general scientific maxims, not upon any foundation of detailed observation. I am myself inclined, as a working hypothesis, to adopt the belief in question, and to hold that past experience only affects present behaviour through modifications of physiological structure. But the evidence seems not quite conclusive, so that I do not think we ought to forget the other hypothesis, or to reject entirely the possibility that mnemonic causation may be the ultimate explanation of mnemonic phenomena. I say this, not because I think it LIKELY that mnemonic causation is ultimate, but merely because I think it POSSIBLE, and because it often turns out important to the progress of science to remember hypotheses which have previously seemed improbable.

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