

THE MNEMIC PRINCIPLE APPLIED TO BIOLOGY AND PSYCHOLOGY.

BY

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THE book on "the Mneme" (*μνήμη*, memory) by the late Richard Semon of Munich¹ is a work of great importance and scientific interest, for even if some of the premisses upon which the author founded his theory that memory, habit, and heredity were factors of one common principle (the mnemonic principle) are either inconclusive or even to some biologists unacceptable, nevertheless the attempt he made cannot fail to have a profound influence upon psychology and biological science.

This mnemonic theory is not new; four independent attempts to connect the phenomena of memory, habit, and heredity prior to Semon's had been made by Hering, Samuel Butler, F. Laycock, and Henry D. Orr, but not one of them seems to have made any real influence upon contemporary scientific thought, for they all omitted to explain definitely why such dissimilar processes should possess in common an obviously repetitive nature. Bertrand Russell, in his recent book *Analysis of Mind* (Chapter IV, Influence of past history on present occurrence in living organisms), adopts the term "mnemic phenomena" for those responses of an organism which, as far as observed facts are concerned, can only be brought under causal lines by including past occurrences in the history of the organism as part of the causes of the present response.

Semon points out that the immediate effect of stimulus upon irritable organic matter is excitation, but that the excitable condition manifested is really only half the effect produced, for although the irritable substance after the cessation of the stimulus returns to an indifferent state there remains a primary latent modification, a physico-chemical change, which Semon terms an "engram." The engraphic effects of a stimulus, then, are: (1) excitation, (2) an engram. The capacity of an organic substance to be engraphically affected constitutes the mnemonic principle.

The engrams of an irritable substance are the altered dispositions of it towards recurrence of states of excitement produced by the original stimuli. The organic substance, in consequence of specific engraphic action, shows itself specifically predisposed to those states of excitement which were induced by the original stimulus or by stimuli in juxtaposition, coacting either simultaneously or successively. Coacting stimuli received by the organism are reproduced mnemically in juxtaposition. Thus two experiences A and B occurring simultaneously ephorize (*ἐκφορέω* or *ἐκφέρω*, to carry out or away) A and B in simultaneous juxtaposition. Experience A can ephorize B, or the converse. If, however, experiences A and B are successive, A can ephorize B but B cannot ephorize A. This is quite obvious in reciting a poem. In singing a song we know that the music can ephorize the words and the converse, because the word and the tune are simultaneous. An interesting fact in connexion therewith is that cases of aphasia have been recorded in which a song could be sung right through, although the words could not be uttered without the musical tones. I published an interesting case of this in a soldier who was blind and suffered with right hemiplegia and aphasia in consequence of a bullet wound of the brain. Recently Professor Bianchi has published a remarkable case of a man with thrombosis of the left middle cerebral artery, causing complete aphasia, who was able to sing popular Neapolitan songs. Most people know how easy it is to sing a song after it has been started correctly, and how difficult it is to memorize the tune and the words if interrupted; indeed, it is necessary often to begin the bar or the verse again. A well known song when once started voluntarily is followed by a successive ephory of a series of associated tonal and articulate engrams. The series of incoming auditory and kinaesthetic stimuli successively and automatically ephorize the corresponding motor engrams in the form of a chain of reflex patterns. Attention, not being directed to correctness of tone or the memory of the words, can be devoted to expressive feeling and clear diction. Awareness of the correctness of the words and tone only enters clear consciousness demanding attention when a slip or fault occurs.

The individual stimulus does not liberate one isolated synchronous excitation and make an isolated engram. Such detachment is wellnigh impossible in nature. What we find is this: that a simultaneous excitation complex, as such, after the lapse of the synchronous excitations is engraphically fixed in its totality. That which remains is a simultaneous "engram-complex." This simultaneous complex is the product of the excitations resulting from the entire energetic condition, and by energetic condition Semon means not only the external energies affecting the organism, but also its internal energetic state. The latter is just as important as the forces acting on it from without.

Because only a small fraction of a simultaneous excitation complex manifests itself clearly on mnemonic reproduction we get the impression, not of the recurrence of a former complete energetic condition, but only of a specific section. The internal energetic condition of an organism varies greatly at different times, so that the same external energetic condition produces at various moments altogether different simultaneous excitation complexes.

The Mnemic Principle Applied to the Three Primal Instincts.

I will now endeavour to apply the mnemonic principle to the three primal instincts. The following quotation from Bertrand Russell (*Analysis of Mind*) shows that the application of the mnemonic principle to the primal instincts of self-preservation, preservation of the species, and gregariousness is accepted by this profound psychologist.

"The response of an organism to a given stimulus is dependent upon the past history of the organism, and not merely on the present stimulus and the hitherto discoverable state of the organism. In the case of living organisms practically everything that is distinctive both of their physical and mental behaviour is bound up with this persistent influence of their parts. Further, speaking broadly, the change in response is usually of a kind that is biologically advantageous to that organism."

An inherited permeability or tendency to "permeability of neuronics routes" (Lloyd Morgan), synonymous with "engrams," connected with the primal instincts when appropriate stimuli arise, predetermine the instinctive behaviour of animals. For this reason chicks as soon as they are hatched seek and pick up food. In the human being sucking is the only complete instinctive act; the instincts of man are nearly all overlaid and consolidated by acquired habits. Owing to the great development of his psychic neuronics system man, moreover, is enabled to inhibit and control instinctive reactions.

Now instinctive neuronics routes are permeable because the chains of neuronics which form the routes have, in the long procession of ages of evolution, engraven in them engrams of successively repetitive stimuli, thereby permitting a stimulus appropriate to one of the three primal instincts (self-preservation, preservation of the species, or gregariousness), immediately or very readily to excite them successively, and bring about a specific inherited series of purposive reactions—in fact, a chain reflex. As all reactions are primarily sensory-motor reflexes, once the stimulus starts a motor reaction an incoming proprioceptor sensory stimulus from the parts moved correspondingly occurs to act as an incoming stimulus to arouse successive latent engrams connected with the instinctive purposive and unforeseen end (see figure). For instinct is blind.

Instinct of Self-Preservation.

With respect to self-preservation we may take an example given by Semon. A dog barks with delight to fetch a stone which you pick up and throw for it to fetch and carry, and every time you bend down to pick up a stone the dog barks with delight in anticipation of fetching and carrying it; but if, instead of throwing the stone for him to fetch, you throw it at the dog and it hits him, a nociceptor stimulus of the skin is produced and the dog, when next he sees you bend down, instead of barking with delight and wagging his tail, runs away howling with tail down. Clearly the engrams produced by nociceptor stimuli are more easily revived than engrams associated with beneceptor stimuli. Adopting, again, the term of Lloyd Morgan of "permeable neuronics routes" for engrams, we may assume that the neuronics routes of nociceptor are innately more permeable than beneceptor stimuli, which hypothesis is supported by Sherrington's experiments on the spinal animal.

We see in this observation that the visual stimulus of bending down ephorizes a previous painful experience, but

¹ *The Mneme*. By R. Semon. Translated by L. Simon. London: G. Allen and Unwin, Ltd.; New York: The Macmillan Co. 1923. (Demy 8vo. pp. 293. 18s. net.)

before painful experience of the stone striking the skin can occur a protective behaviour, accompanied by the emotional expression of fear, is excited. This fact shows (1) that a complete repetition of the original condition is not necessary in the application of the mnemonic principle, and (2) that painful stimuli have a more powerful influence in preservation of the individual than pleasurable stimuli.

The Sex Instinct.

A subtle chemical stimulus such as the sexual hormone circulating in the blood may be regarded as the initial stimulus which arouses inherited latent engrams connected with propagation; and in animals the behaviouristic series of the chain of reflex patterns once started proceeds successively through permeable neuronic routes to a purposive end. The sex instinct in human beings is likewise automatically aroused by specific male and female sex hormones. The subjective manifestations are at first vague, uneasy feelings with an unconscious desire for relief; this unconscious vague spontaneous desire sooner or later arouses latent engrams of conscious desire and purposive behaviour towards the opposite sex, such as endeavours to attract attention by display accompanied by the sentiments of pride and vanity, which finally under normal conditions culminate in a passion (love) in which the male plays the active part and the female the apparently passive part, though it is the apparent passivity of the magnet.

The Gregarious or Social Instinct.

As an example of the inherited instinct of gregariousness a dog in chasing a rabbit barks instinctively to call up the pack because there are pre-organized permeable neuronic routes associating olfactory and visual images of the chase with the neuronic structures connected with barking, although the dog by barking may defeat the purposive end of capture of his prey. How different is the behaviour of the solitary hunter, the cat!

The Mnemic Principle Applied to Ontogenesis.

Can this mnemonic principle be applied also to ontogenesis? *A priori* we should expect that it could, for ontogenesis is in a measure a recapitulation of phylogenesis. Progressive evolution in the animal series depends upon the establishment of preorganized latent engrams (connected with the three primal instincts) in the body as a whole, but in the nervous system in particular. These latent engrams which are necessarily ephorized are so adapted to feeling and behaviour of *homo sapiens* for the preservation of the individual and the species as to promote natural selection and survival of the fittest. The male and female gonads are each respectively the bearers of latent specific dispositions peculiar to species, race, and familial ancestry. The initial stimulus to an orderly sequence of stimuli for developmental formative structural activities is the conjugation of the male and female gonads; once started there follows automatically an ephory of latent engrams peculiar to species, sex, race, and ancestry by stimuli which have been successively repetitive during the long procession of ages of evolution. The engrams of species are immutable, and in a great measure also those of race; but the particular mental and bodily characters of the individual depend upon latent engrams derived from race, and those due to familial ancestry are plastic, therefore mutable, and most subject under the influence of environmental stimuli to variations.

The Mnemic Principle Applied to Habit.

Habit is distinct from instinct. Habitual actions are acquired by conscious voluntary attention to trial by failure and success of sensory-motor activities for a purposive end, repeated until a successive series of engrams or permeable sensory-motor neuronic routes has been established; and it is then only necessary to will the first movement for the rest of the reflex patterns to follow automatically in orderly sequence until the end is attained. In an habitual action, once the chain of reflex patterns has been initiated, conscious voluntary attention is no longer required; but should any interruption or failure of perfect ephory of successive engrams occur, there is awareness, and effort is made to supply, correct, or adjust the defect. This may be explained by a diagram showing the permeable neuronic routes which repetitive successive stimuli have created.

The Mnemic Principle Applied to the Influences of Inherited Dispositions.

The transmission of acquired characters is a heresy to most biologists, but Semon says (p. 84): "In a limited but fairly imposing number of cases we are able to influence inherited dispositions so effectively that the newly added engram not only remains in force during the individual life of the organism, but is transmitted to the offspring." Attention is directed to certain experiments, the most convincing of which are those of P. Kammerer:

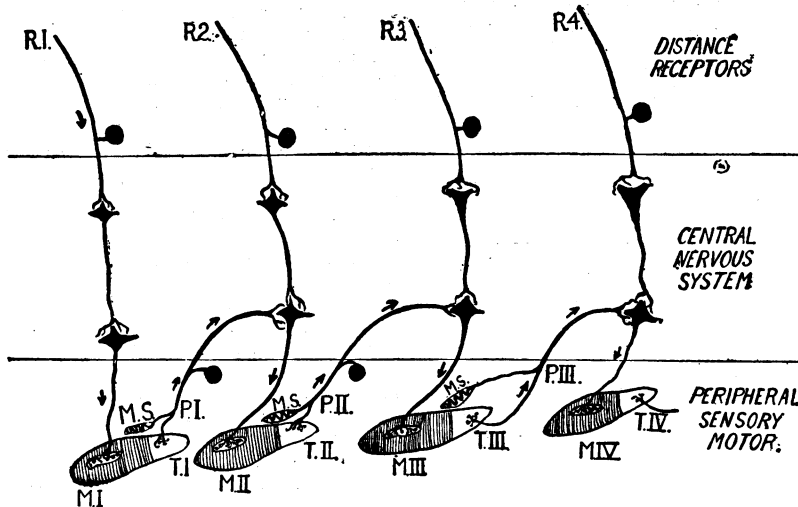
"The so called fire newt, *Salamandra maculosa*, which is viviparous, ordinarily gives birth to larvae measuring on the average 25 mm. and carrying gills. The broods may number anything from 14 to 72. These larvae are deposited in the water, and there pass a long transitional stage, until, after several months, they lose their gills, leave the water, and completely change into land newts. By change of conditions Kammerer succeeded in forcing the females to retain their offspring for a longer time in the uterus. Then, by repetition of coercion, these re-

tarded parturitions became habitual. In order to induce the females that had previously borne normally to retain their offspring in the uterus beyond the usual time, Kammerer kept them from the water-trough in which they would ordinarily have deposited their larvae." Kammerer now reared young, born of animals which had reached the highest stage of habitual late parturition, and mated them with each other. He then subjected the females to normal conditions during pregnancy, by supplying them with a water-trough and moist air, and by maintaining them at a moderately high temperature. Although there was no longer any external coercion to late parturition, the creatures departed from the normal breeding mode of their species, and without exceptions from the beginning made late and sparse births.

As the validity of these experiments of Kammerer and others, upon which Professor Semon based his views of the possibility of the influence of environmental stimuli upon the germ cells, is doubted by biologists, I will quote the following verbal communication made to the meeting of the Royal Society on January 18th, 1923, by Professor E. W. MacBride, F.R.S.:

"It is well known to zoologists that during the last fifteen or twenty years a series of experiments have been carried out by Dr. Kammerer at Vienna, which tend to show that acquired qualities, or, in other words, modifications of structure induced by modified habits, are inheritable. The results of these experiments have been received with much scepticism, both here and on the Continent, and the *bona fides* of Dr. Kammerer has been called in question.

"One of the most interesting of his experiments was in inducing *Alytes*, a toad which normally breeds on land, to breed in water. As a result, after two generations, the male *Alytes* developed a horny pad on the hand, to enable him to grasp his



Diagrammatic representation of the formation of a serial-response habit (after Dunlap, slightly modified). The series of responses is at first the result of the successive stimulation of the distance receptors shown at the top of the figure. During practice this stimulation is accompanied by the stimulation of proprioceptors in the acting muscles. This proprioceptive stimulation gives rise to nervous impulses that are drained as indicated by the arrows into the acting system, and in time the series of responses may be elicited by these movement-produced stimuli, only the first of the distance receptor stimuli being necessary. M., Muscles; P., proprioceptors; m.s., muscle spindles; T., tendon joint.

slippery partner. It has been admitted by Kammerer's critics that if he could demonstrate this pad he would to a large extent succeed in establishing the validity of his results.

"This summer, at my request, Mr. J. Quastel of Trinity College, Cambridge, when in Vienna, interviewed Kammerer, and was shown by him one of these modified males. . . . Subsequently, at my request, the Zoological Society dispatched Mr. E. Boulenger on a visit to Vienna. He too saw the modified male, and was assured by Przi Bram, the head of the Biological Institute, that all Kammerer's experiments had been done under his (Przi Bram's) supervision, and were perfectly genuine."

Semon from these and many other experiments claims "that a stimulus affecting the irritable substance of an organism and inducing excitation therein may in some cases affect also the germ cells, leaving demonstrable engrams behind, but that in other cases the germ cells are unaffected."

He claims that the mnemonic theory does not conflict with the Mendelian doctrine. He asserts that "it is not Darwin, but Weismann, who has been retuted by the more recent data acquired in the course of experimental research into the laws of heredity."

In the following statement he shows how the mnemonic principle may be applied to natural selection and survival of the fittest:

"In the mneme there is to be found a conserving principle which is indispensable for organic development, in so far as it preserves the transformations which the external world unceasingly creates. Its conserving influence is, of course, restricted by that indirect factor of the external world, Natural Selection, for, in the long run, only fit transformations survive."

Nova et Vetera.

THE INDIAN POLITICAL DEPARTMENT.

In a note on the recent retirement of Major-General Sir William Edwards, the late Director-General of the Indian Medical Service, it was stated that he had passed great part of his service in the political department. This statement probably conveyed little or no information to readers in this country, to whom the nature of the Indian Political Department is unknown. This department corresponds roughly to the British Diplomatic Service. It deals with the relations of the Government of India with the independent countries bordering on India; Afghanistan, Tibet, Nipal, etc., and with the numerous semi-independent Indian native states. It has always been considered the most important department of the Government of India. In the distribution of portfolios among the members of the Indian Government the Viceroy retains that of the political department in his own hands. Under him its immediate head is the Foreign Secretary, of late years always a member of the Indian Civil Service. It has hitherto been recruited from officers of the I.C.S. and of the Indian army in about equal proportions, but for some years past the tendency has been to increase the number of civil officers at the expense of the military. But while these two services have always contributed the greater part of the personnel of the political department, the Government have always exercised the right of taking officers whose services were considered useful or necessary from any department of Indian service, medical, public works, police, etc. The highest appointments in the department are the chief commissionerships of British Biluchistan and of the North-West Frontier Province; the agencies of the Governor-General, Central India and Rajputana; and the residencies of Nipal, Haidarabad, Kashmir, Maisur (Mysore), and Baroda. After them come second class residents, political agents, and political assistants, the whole forming a regular graded service, with regular promotion from grade to grade. The Government, however, frequently fills up the highest appointments from outside the department. Service in the political department has always been the quickest and best route to success and fame. Many of the best known names in modern Indian history are those of political officers, especially in the middle of the nineteenth century, while the British Empire in India was rapidly expanding: Sir John Malcolm, a century ago; Sir Alexander Burnes, assassinated at Kabul in 1841; Sir Herbert Edwards, of Punjab fame; John Nicholson, who fell in the siege of Delhi; and, greatest of all, the Lawrence brothers, John Lord Lawrence and Sir Henry Lawrence, killed at Lucknow, were all "politicals." All of these, except John

Lawrence, were military officers. Coming nearer our own times, we may add the names of Sir Louis Cavagnari, killed at Kabul in 1879; Sir Robert Sandeman, of British Biluchistan; and Sir Francis Younghusband, who is happily still living.

In addition to the executive officers of the political service, every political residency and agency, except a few of the smallest, has a medical officer attached to it. These posts have always been filled from the Indian Medical Service, and when it is stated that an I.M.S. officer is in political employ, or in the political department, this means that he is attached to the department as a medical officer, not that he is an executive political officer. As a rule, the medical officer enters political employ fairly young and is posted to one of the less popular stations, rising gradually to pleasanter and more lucrative appointments. And some of the higher posts under the Foreign Office are among the most important and lucrative medical appointments in India. But, as in the case of executive officers, it sometimes happens that a senior medical officer is appointed from some other branch of the medical service direct to one of the most important posts under the Foreign Office. As an instance may be mentioned the late Colonel Lawrie, who was transferred from being Professor of Surgery at Lahore to be Residency Surgeon at Haiderabad, a post which at that time was usually considered the best medical appointment in India.

As stated above, the Government has always selected for employment in the political department officers of any service whom they considered likely to make successful political officers. And, from time to time, many officers of the I.M.S. have been so selected, usually after a period of service as medical officers of the department. A few names may be mentioned as the best known, though there have been many others. Surgeon Graeme Mercer, of the Bengal Medical Service, in the early years of the nineteenth century was Resident at the Court of Scindia, the Maratha chief, ruler of the then independent state of Gwalior. The well-known work, *Letters from a Maratha Camp*, was written by Lieutenant (afterwards Colonel) T. D. Broughton, while commandant of the Resident's (Mercer's) escort. Sir John McNeill, while an assistant surgeon in Bombay, was appointed medical officer to the British Mission in Persia in 1820, and in 1835, after fifteen years' service in that capacity, became secretary to the embassy. He retired from the medical service in 1836, and in the same year was appointed Minister Plenipotentiary to Persia, holding that post for six years, till 1842. On April 15th, 1839, he received the Grand Cross of the Bath, being the only I.M.S. officer who has ever gained that honour. He lived till May 17th, 1883. Percival Lord, also of the Bombay service, after accompanying Sir Alexander Burnes to Kabul, in 1836, when the British restored Shah Shuja to the throne of Afghanistan and occupied the country, in 1839, was appointed Political Officer on the Uzbek frontier, where he was killed in action in the battle of Parwandara on November 2nd, 1840. Sir John Spence Login, of Bengal, after serving with D'Arcy Todd at Herat, in the Afghan war, 1839-42, joined the political department. He was appointed tutor to Dulip Singh, the child Maharajah of the Punjab, deposed in 1849, after the second Sikh war. Deputy Surgeon-General Henry Walter Bellew, author of many works on Afghanistan, was at Kandahar during the Mutiny, and afterwards served for several years in the political department, being chief political officer at Kabul during the second Afghan war, but later left it for the smoother paths of the sanitary department. The last I.M.S. officer who served as an executive political officer was the late Sir George Robertson. He entered the Bengal Service in 1878 and joined the political department ten years later. He was chief political officer in the Hunza-Nagar campaign of 1891-92, and afterwards political agent of Chitral, a small state on the North-West frontier, and as such went through the siege of Chitral, for which he received the K.C.S.I. He retired on October 12th, 1899, and since then the I.M.S. has not been represented in the executive ranks of the political department. After his retirement Robertson was M.P. for Central Bradford for ten years, from 1906 till his death on January 2nd, 1916.

THE seventy-fifth anniversary of the Société de Biologie of Paris will be celebrated on May 26th. The subjects to be discussed are: generation and fecundation, introduced by A. Brachet; physiological action of potassium and calcium, introduced by H. Zwaardemaker; the problem of immunity in invertebrates, introduced by J. Cantacuzène.