

SENSATION AND PERCEPTION

II.

THE doctrine that there is a distinct organ for the realisation of Sensations only, apart from that for Perception, has been very generally taught, and has been insisted on by no one more strongly than by Dr. Carpenter in his otherwise most able and suggestive expositions of nervous physiology. He says: * "The general rule of action appears to be that the impressions made by external objects upon the afferent nerves, when transmitted to the spinal cord, ascend towards the cerebrum without exciting any reflex movements in their course. When such an *impression* arrives at the sensorium,† it excites the consciousness of the individual, and thus gives rise to a *sensation*; and the change thus induced being further propagated from the sensory ganglia to the cerebrum, gives occasion to the formation of an *idea*." And that Dr. Carpenter here means by the word 'idea' what we have previously spoken of as that complex intellectualised sensation generally called a 'perception,' seems obvious from the following passage occurring on another page, where the same author says: "It is further important to keep in mind the distinction between the *sensations* themselves and the *ideas* which are the immediate results of those sensations when they are perceived by the mind. The ideas relate to the *cause* of the sensation or the object by which the impression is made" (p. 711). But since, in Dr. Carpenter's view, the sensory ganglia constitute the *sensorium*, in which impressions become conscious sensations; and because he naturally thinks it very improbable that there are two distinct organs of consciousness, he is compelled to adopt the hypothesis that the superficial grey matter of the cerebral hemispheres, in which intellectual operations are principally carried on, is not itself endowed with the function of consciousness. Thus he assumes—as the most probable inference to be drawn from various kinds of evidence—"that the sensory ganglia constitute the seat of consciousness not merely for impressions on the organs of sense, but also for changes in the cortical substance of the cerebrum; so that until the latter have reacted downwards upon the sensorium we have no consciousness either of the formation of ideas or of any intellectual processes of which these may be the subject."‡ And, although we are quite unable to agree with the conclusions themselves as to the absence of consciousness in connection with the activity of the cerebral hemispheres, and as to its presence as a functional attribute of the sensory ganglia alone, still it is sufficiently interesting, in a philosophical point of view, to find Dr. Carpenter declaring so confidently in favour of a distinct organ of consciousness, even altogether separate from those parts of the cerebral hemispheres in which what we have called § *potential knowledge* is produced—meaning by this term what is called knowledge, so far as it can exist *minus* the attribute of consciousness. The elaboration of this potential knowledge is, in fact, a process the possibility of which has been ably discussed by Dr. Carpenter in the section in which he speaks of "unconscious cerebration."

We must, however, briefly inquire into the reasons which have induced Dr. Carpenter to regard these so-called sensory ganglia as the seat of consciousness; though, before doing so, it will be well to draw the reader's attention to the following considerations. As it is quite true that different nerves, coming from the sense organs or surface of the body generally, do pass through the sensory ganglia on their way to the higher centres in the cerebral hemispheres, it is obvious that the impressions made upon any one of these lower centres must be *qualified* to a

certain extent, inasmuch as they are the middle terms of a series, and therefore are related to their antecedents and to their consequents in the same way that these are related to one another—the antecedents being the external impressions, and the consequents the resulting perceptions. For, when an impression of a certain kind is made upon any given part of the surface of the body, this impression traverses definite nerve-fibres, in order to reach functionally related portions of the cerebral hemispheres, and so we may well suppose that the fibres, on their way, must necessarily pass through *definite parts* of the sensory ganglia, and produce, in certain of the ganglionic elements there situated, impressions of a *definite kind*.

Thus, therefore, although we may believe that no state of consciousness is aroused by this molecular action taking place in these lower sensory ganglia, the impressions made upon them may be, nevertheless, definite enough in kind and place to ensure a partial transference of such molecular movement along given and accustomed outgoing motor channels; such organic possibilities of motorial response having been slowly built up and elaborated, in past time, under the guidance of then co-existing and related conscious states. Thus, movements may at times be produced in every way similar, as regards mode of origin, to those automatic or reflex movements occurring through the intervention of the spinal cord alone; though they may be as much more complex, and apparently purposive, as these higher centres are more complex than the spinal centres. And it is, we think, because the movements are produced by reflections from the highest motor centres, *whose complexity renders the most purposive movements possible*, that such movements have been supposed to be invariably the sequences of conscious impressions or *sensations*, and have hence received the appellation of *sensori-motor*. This name, however, begs the question in dispute—as to whether impressions reaching thus far would be revealed in consciousness or not; and from what has been already said it will be seen that in the settlement of this question we must not rely too much upon the purposive nature of the movements as evidence that they are the results of conscious impressions. Reasonings of this kind led Pfüger to suppose that the spinal cord was also a seat of consciousness.

We quite agree with Dr. Carpenter* and others, however, in the opinion that the organic possibilities of executing all combined muscular movements of which the individual is capable, reside in the spinal cord and medulla, and also still higher in the motor centres in immediate connection with these so-called sensory ganglia—by virtue of definite nerve connections therein established. So that all the facts with which we are acquainted, as he says, "tend strongly in favour of the view that even voluntary movements are executed by the instrumentality of the automatic apparatus, and that they differ only from the automatic or instinctive in the nature of the stimulus by which they are excited." This doctrine may be aptly illustrated by reference to the act of coughing, since this is an instance in which a complicated set of movements usually produced automatically may nevertheless be incited by a voluntary determination. When so produced, the will is directed to the production of the result as a whole; no attempt being made to single out the different movements, and then to combine them; so that, as Dr. Carpenter also says, "the will thus seems obviously to take the place of the laryngeal or tracheal irritation as the *primum mobile* of the series, which, in its actual performance, is as automatic in the latter case as in the former." In each case, the same organised set of nerve connections in the higher motor centres (constituting the organic representatives of the combined muscular movements of the act of coughing) are called into activity; now by a volitional incitation descending from the cerebral hemispheres, and, at another time, as a result of an afferent stimulus reaching the

* Principles of Comparative Physiology, fifth edition, p. 707. 1854.

† Constituted by certain ganglionic structures at the base of the brain, in relation with the various sensory nerves, and usually spoken of as the *sensory ganglia*.

‡ Loc. cit., p. 546.

§ See paper on "Consciousness," in *Jour. of Ment. Science*, p. 512.

* Human Physiology, fifth edition, p. 526.

related sensory centres from some part of the respiratory passages themselves.

Bearing these facts in mind, and also the psychological view of the essential unity in the mode of evolution of all sensations or conscious states—whether simple or complex—we shall find that the performance of many acts of the so-called *sensori-motor* type do not necessarily lend such support to the supposition that the sensory ganglia are the seats of consciousness as they have been supposed to do. That the movements of an infant or of an idiot should appear to be automatic in nature, is only to be expected if we consider that they are responses to conscious impressions excited in quite undeveloped cerebral hemispheres, in which, as yet, the possibilities of intellectual and volitional action of the lowest type only are organised. Thus, the only action which at this time could possibly emanate from the operation of the intellectual centres would be such as Dr. Carpenter has supposed to depend upon the stimulus of mere sensations; and it does not at all follow, as he seems to suppose, that such movements are excited by sensations, realised as such in the sensory ganglia and thence reflected without the intervention of the cerebral hemispheres. Neither do we think his doctrine receives any stronger amount of support from the fact of our ability to perform certain *habitual* movements whilst the cerebrum is occupied with some engrossing train of thought.

It is, we think, an altogether improbable assumption to suppose that the so-called "secondary automatic" acts take place, as a general rule, altogether without the intervention of the cerebral hemispheres. Taking the instance cited by Dr. Carpenter, of the individual who, falling into a deep reverie whilst making his way through the streets, nevertheless walks with ease along accustomed routes, though his attention may be entirely absorbed by some particular train of thought, it is supposed that these movements are characteristic instances of *sensori-motor* acts, that they are brought about solely by reflections from some of the sensory ganglia, and without the intervention of the hemispheres. But it seems to us much more reasonable to suppose that the cerebral hemispheres have been concerned to some extent, even though the consciousness of the individual has been otherwise monopolised. In proportion to the frequency of the repetition of such movements—to the degree in which they have become habitual, so can we the more easily understand that the cerebral action involved may take place without arousing consciousness, and so quite independently of trains of thought which are monopolising the person's attention. A motor incitation now really volitional, may, though similar in all other respects, at another time be purely reflex and unconscious, even though passing over from regions of the cerebral hemispheres themselves;* the consciousness or the unconsciousness of the incitation depending upon the particular direction of the attention of the individual at the time being. This view seems rendered all the more probable if we consider what are the effects on man of even small injuries of parts of the cerebral hemispheres above the level of the sensory ganglia. If, in the instance above alluded to, the person maintains the erect position, and even walks perfectly well, through the intervention of nerve-centres no higher than the sensory ganglia, how is it that the same man would be completely paralysed on one side of his body for months or perhaps years by an effusion of blood into, or a softening of, a portion of brain tissue quite above these sensory ganglia—by a lesion, for instance, of a portion of the opposite hemisphere outside its *corpus striatum*? We may set such an individual upon his legs as often as we choose, but no amount of mere sensory impressions are capable of exciting the supposed *sensori-motor* movements; the paralysed limb

is utterly powerless, and even the mere attitude of standing, when the individual is unsupported, is found to be impossible.

The experimental evidence which has been appealed to is also capable of receiving different interpretations; and, indeed, physiologists themselves have already expressed directly contrary opinions upon this subject. The evidence is, in fact, of such an uncertain nature as to be quite incapable of leading to a very definite conclusion, unless we have formed some decided opinion as to the real nature of a sensation, and as to how this differs from what is called a perception. Flourens denies, for instance, that birds or mammals whose cerebral hemispheres have been removed are any longer capable of appreciating sensory impressions; whilst Magendie, Longet, Vulpian, and many others maintain that such animals are capable of feeling simple sensations, and that they are therefore, to a certain extent, in possession of consciousness. But it may be fairly maintained that the way in which such animals respond to external influences acting upon them are explicable without postulating the existence of consciousness, if we bear in mind that they do still retain their sensory ganglia and all the related motor centres in organic connection with these; and if we bear in mind also what has been already said as to the degree in which impressions, reaching only so far as these sensory ganglia, and not revealing themselves in consciousness at all, are, nevertheless, *qualified*, and therefore capable of exciting those purposive movements which exist potentially in the related motor centres in the form of definite nerve connections. The molecular mobility of these centres has only to be disturbed in order to bring about, with machine-like precision, the natural movements themselves. Longet and Vulpian look upon the *pons Varolii* as the seat of *general sensibility*,* and there certainly seems much more evidence in favour of this view than in support of the doctrine of Dr. Carpenter that such is the function of the optic thalami. Evidence of different kinds seems quite opposed to the latter view; but much may be said—even though, as we think, to little purpose—in favour of the opinion of Longet and Vulpian. The *corpora quadrigemina* are similarly supposed to be the seats of perception for optical impressions. And one of the strongest facts that has been recorded in favour of the supposed *sensori-motor* nature of certain movements was observed in a pigeon, which lived eighteen days after its cerebral hemispheres alone had been removed by Longet. When this animal was taken into a dark room, every time a light was brought near its eyes the irides contracted, and often even winking occurred; "mais chose remarquable," Longet says,† "aussitôt que j'imprimais un mouvement circulaire à la bougie enflammée, et à une distance assez grande pour qu'il n'y eût point sensation de chaleur, le pigeon exécutait un mouvement analogue à sa tête." Nevertheless, it is said that this same animal sometimes seemed to avoid obstacles, and sometimes knocked himself against them. So that when we consider how closely the movements of the eyes are bound up with visual impressions generally, this following of the strong light, which seems so much to suggest consciousness, may be capable of explanation without having recourse to such a supposition. Dr. Carpenter has called attention to the fact that when the eyelids are closed, if we attempt to move the eye-balls in any given direction, we can only do this with considerable difficulty, and with an extreme sense of effort—"This sense being the result of the state of tension in which the muscles are placed by the effort to move the eyes without the guiding visual sensation." He then adds:—"Now, on the other hand, the will may determine to fix the eyes upon an object; and yet this

* These conclusions were arrived at from an observation of birds and mammals whose cerebral hemispheres, corpora striata, thalami, corpora quadrigemina, and cerebellum had been all removed, leaving within the cranial cavity only the *pons*, or *tuber annulare*, and the medulla. (Longet, "Traité de Physiologie," 3rd ed. t. iii. p. 156.)

† Loc. cit. p. 428.

* See article on "Physiology of Thinking," *Fortnightly Review*, Jan. 1869.

very fixation may be only attainable by a muscular movement, which movement is directly excited by the visual sense without any exertion of voluntary power over the muscles. Such is the case when we look steadily at an object whilst we move the head from side to side; for the eyeballs will then be moved in a contrary direction by a kind of instinctive effort of the external and internal recti, which tends to keep the retina in their first position, and to prevent the motion of the images over them." These are said to belong to the category of voluntary movements, and yet we are not ourselves conscious that they are taking place; we know of it only, as Dr. Carpenter says—or rather learn to infer the existence of such movements in ourselves—by observing what takes place in other persons. We must make due allowances, therefore, for facts like these, when attempting to interpret what takes place in animals from whom a part of the brain has been removed; and we must also bear in mind that the endowments of the lower nerve-centres are different amongst different classes of animals, before we come hastily to the conclusion that movements of the kind mentioned in the pigeon were indicative of consciousness on its part; and still more before we conclude from such phenomena that the sensory ganglia in man are also seats of consciousness. As regards motor power, the differences are most notable amongst different groups of animals. Thus, after complete removal of the cerebral hemispheres, fish, reptiles, birds, and the lower mammalia experience extremely little diminution in their powers of movement. Carp and frogs continue to swim as well as before; a pigeon when abandoned in the air flies to the ground, settling lightly on its feet; whilst a rabbit runs away when irritated, performing these movements with no appreciable difficulty, and with only a slight evidence of weakness. The weakness becomes much more notable when the operation is performed upon a dog, though it is less marked in proportion as the animal is a young one. An adult dog deprived of his cerebral hemispheres is, however, no longer capable of maintaining the erect position, though it can still move its legs freely whilst lying down.

The effect in man, of even limited injuries to one or other hemisphere, in producing paralysis of the opposite side of the body, has been already referred to. Such variations must be taken into account in our interpretations of Longet's experiments with the pigeon. But even Longet himself, though he makes the *pons* the centre for general sensibility and the *corpora quadrigemina* the centre for visual sensations, seems, after all, to entertain considerable doubts or to whether he is warranted in making use of the word "sensation." Thus he says: "Certes en prenant le mot *sensation* dans son acception rigoureusement métaphysique, et ne l'appliquant qu'à tous les cas d'exercice de la sensibilité avec *conscience*, on devra admettre que la protubérance, siège de la sensibilité générale, et les lobes cérébraux, siège de l'intelligence, doivent nécessairement mettré, pour ainsi dire en commun leur activité, et concourir au même acte." But then he adds, "Mais à la rigueur, ne pourrait-on pas permettre aux physiologistes de distinguer la *perception* simple (en quelque sorte *brute*) des impressions, de l'attention qui leur est accordée, de l'appétit à former des idées en rapport avec elles?" To this question we would reply that the power of simple perception with which Longet wishes to endow these lower centres is probably not attended by Consciousness, as he himself seems to intimate, and therefore such a word is altogether unsuitable to express that *unconscious discrimination* of impressions, which may be followed by apparently purposive movements, resulting from the excitation of these lower centres. How this unconscious discrimination may occur, and how it may result in definite movements, have been shown.

Thus, we think the experimental evidence leads us to the conclusion that *unconscious* or *organic discrimination* takes place in the sensory ganglia, just as it takes

place in the spinal cord; only that the discrimination in the former is of a higher type, and results in the more purposive movements, because it takes place in nerve-centres of higher rank. For the production of a distinct state of feeling or sensation, however, even of the simplest kind, conscious intellect is needed, and this cannot be brought into operation without the conjoint activity of the cerebral hemispheres.

We do not consider that such a conclusion is in the least shaken by the evidence furnished by comparative anatomy, notwithstanding what Dr. Carpenter* says to the contrary. He writes as follows:—"Thus we are led by the very cogent evidence which comparative anatomy supplies, to regard this series of ganglionic centres as constituting the real *sensorium*, each ganglion having the power of rendering the mind conscious of the impressions derived from the organ with which it is connected. If this position be denied, we must either refuse the attribute of consciousness to such animals as possess no other encephalic centres than these, or we must believe that the *addition* of the cerebral hemispheres in the vertebrated series alters the endowment of the sensory ganglia,—an idea which is contrary to all analogy." We feel most surprised that Dr. Carpenter should have expressed this latter view; in the first place, because it is quite adverse to the general doctrines of Von Baer, or, in other words, to the doctrines of Evolution which he has done his best to elucidate; and, secondly, because such a notion is opposed to the information afforded by actual experiment as to the alteration in the endowment of the motor centres (to which we have already referred) in ascending the vertebrate scale. As specialisation of structure occurs, so must we get specialisation of function; and we are glad to find that an idea, long familiar to ourselves, has also occurred to Mr. Herbert Spencer, and has been thus clearly expressed by him †:—"It does not follow, as it at first sight seems to do, that feelings are never located in the inferior nervous centres. On the contrary, it may well be that in lower types [of animals] the homologues of these inferior centres are the seats of consciousness. The true implication is, that in any case the seat of consciousness is that nervous centre to which mediately or immediately the most heterogeneous impressions are brought; and it is not improbable that in the course of nervous evolution, centres that were once the highest are supplemented by others in which co-ordination is carried a stage further, and which, therefore, become the places of feeling, while the centres before predominant become automatic."

The conclusions at which we have arrived have an important psychological bearing. Thus, Herbart in Germany, followed by Sir William Hamilton in our own country, made Cognition or discrimination the fundamental fact of Mind, rather than Sensation or mere feeling (which is regarded as its basis by many others), and it must be confessed that physiological evidence accords with the former rather than with the latter view. In the first place, because no consciousness in the form of sensation can take place without the aid of intellectual activity under the form of cognition or discrimination; whilst, on the other hand, cognition or intellectual action may take place under the form of a mere *organic* or *unconscious discrimination*, without the intervention of consciousness. Thus, in the individual, consciousness or feeling comes to be superadded as an additional accompaniment to certain mere organic discriminations; so that consciousness, without which sensation cannot exist, is secondary, whilst cognition, in the form of unconscious discrimination, is primary. Out of this primary undifferentiated organic discrimination, such as alone pertains to the lowest forms of animal life, there has been gradually evolved that which we know as feeling and consciousness.

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* Op. cit., p. 503. † Principles of Psychology, Oct. 1868, No. 2, p. 105