REMARKS

ON

THE "MUSCULAR SENSE", AND ON THE
PHYSIOLOGY OF THINKING.*

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BUT there is another consideration which deserves our attention in this place, and which of itself also militates against Professor Bain's view that the estimation of weight or resistance is arrived at principally through a "muscular sense" or active mode of sensibility. It is this. It is generally admitted that we can in some way acquire permanent standards of weight which shall be recoverable in idea at will—a fact which Professor Bain well expresses in this way (*loc. cit.*, p. 93): "Absolute weight implies a permanent standard, and a permanent impression of that standard. When I lift a weight, and pronounce it to be seven pounds, I make a comparison between the present feeling and the impression acquired by handling the standard weight of seven pounds or things equivalent thereto. This absolute comparison, therefore, implies the enduring and recoverable sensibility to impressions of resistance, which is also a fact of the human constitution. . . . A receiver of posted letters contracts an ingrained sensibility to half an ounce, and can say, of any letter put into his hand, whether it produces a sensibility equal to or under the standard." Now, seeing it to be admitted that precisely the same parts of the brain, the same nerve-cells and the same nerve-fibres, are always concerned in the ideal recall, as were concerned in the elaboration of the original impression; and seeing that Professor Bain maintains that these impressions of resistance were originally concomitants of that outgoing motor current which excited the muscles to act,—we may well ask whether it would be possible that the mere concomitant could be revived alone, without the muscular action of which it is supposed to be the sign. We know that, when the ideal recall of a past feeling of resistance is brought about, the muscular action which originally took place does not recur, and therefore we cannot believe that the molecular agitation occasioning this ideal recall has occurred in precisely the same circles that were concerned in the production of the original impression. But this would be a conclusion which I am sure Professor Bain would not be prepared to admit. It is one of the fundamental positions of physiological psychology which he has strongly enforced,† that a renewed feeling or idea must depend upon the action of precisely the same parts as the original feeling. Therefore it seems to me, since the ideal recall could never be supposed to comply with these conditions if the original sense of resistance had been derived through the motor nerves by means of a "muscular sense", even this method of reasoning would compel us to reject Professor Bain's conclusions on this subject,‡ if there were not the other points of evidence tending in the same direction. But, if we assume that our perceptions of resistance have been acquired in the way I have indicated—that they are partly made up of tactile impressions, and partly of passive sensations emanating from the muscles, and of inferences founded upon

* Continued from page 439 of last number.

† He says (*loc. cit.*, p. 338):—"What is the manner of occupation of the brain with a resuscitated feeling of resistance, a smell, or a sound? There is only one answer that seems admissible. *The renewed feeling occupies the very same parts, and in the same manner, as the original feeling, and in no other parts, nor in any other assignable manner.*"

‡ Sir Wm. Hamilton's doctrine was somewhat different, though also, as I think, untenable. It is fully set forth in a note appended to p. 864 of his *Dissertations on Reid*. We are in accord so far, that the "feelings of movement" are derivable from purely passive modes of sensibility; only, he maintains, that in addition to these notions of a subjective kind thence derivable, we get our objective notion of "resistance" from our consciousness of expended energy in volitional action (in the same way, in fact, as Müller, Ludwig, Wundt, and Bain, imagine that we derive our impressions pertaining to the muscular sense). Hamilton stated his view in this way:—"The consciousness of the mental motive energy, and of the greater or less intensity of such energy requisite in different circumstances to accomplish our intention, would of itself always enable us to perceive the fact, and in some degree to measure the amount of any resistance to our voluntary movements." Now, the simplest way of testing this statement is to ask a man, whose lower extremities are completely paralysed, whether, when he ineffectually wills to move either of these limbs, he is conscious of an expenditure of energy in any degree proportionate to that which he would have experienced if his muscles had naturally responded to his volition. He will tell us rather that he has a sense only of his own utter powerlessness, and that his volition is a mere mental act, carrying with it no feelings of expended energy, such as he is accustomed to experience when his muscles are in powerful action, and from which action and its consequences alone, as I think, he can derive any adequate notion of resistance.

these—then all difficulties vanish. These passive sensations can, of course, be easily recalled in idea, without any recurrence of the muscular actions by which they were originally occasioned; so that the possibility of forming a *recoverable* ingrained standard of weight is perfectly conceivable. We experience certain feelings of pressure combined with certain sensations in the muscles, and we gradually come to associate certain combinations of these with the sensations produced by handling certain standard weights. The notion of expended energy may well be one which is subsequently superadded to the original sensation; and, of course, any intense state of consciousness, as a mere state of consciousness, does involve an expenditure of energy.

I am not singular in the opinions I have just expressed as to the nature and origin of our "feelings of movement"; for much doubt has arisen in the minds of others who have carefully considered the question, as to the very existence of any conscious impressions which can be said to be appreciable only by means of a "muscular sense". Trouseau has been one of the most prominent objectors to the recognition of this so-called sixth sense, on these grounds. He says: "When, after shutting our eyes, we execute without effort a pretty extensive movement, we are unable, even on paying the strictest attention, to feel the contraction of our muscles, although we may feel the movement communicated to the levers by the contracted muscles. This fact is so true that, when we ask an intelligent person, who knows nothing of anatomy and physiology, which is the seat of the movements through which the fingers are flexed and extended, he immediately points to the hand, and never to the forearm. It is only when the muscular effort is considerable, or is kept up for a long time, that it is perceived where the contraction really occurs. Normally, then, we have no consciousness of muscular activity, but merely the consciousness of the movement itself, which is a perfectly different thing" (*loc. cit.*, p. 159). Then, again, *the feelings during passive movements of a limb are almost precisely similar to those which occur during weak voluntary movements of the same limb*. Our consciousness of the movements in the latter case depends partly upon an inference, and partly upon actual local sensations of the passive kind. He says, further on: "If we shut our eyes whilst we move one hand, for instance, we feel in the palm, and in the palmar surface of the fingers, a sensation of dragging when the hand is opened wide, and a sensation of relaxation when the hand is closed, in addition to a special sensation in the joints themselves, which latter is always striking, and even painful, when we wake up from sleep. As to muscular sensations, they only exist when the contraction is extreme, or when the muscle is in a painful condition, as after a contusion or great fatigue, for instance." I must confess that it seems to me very difficult to understand how persons competent to judge of the evidence can come to any other conclusion; and, practically, very many physiologists are agreed upon this point, up to a certain extent. Müller, Wundt, and Ludwig all admit (and in this respect Professor Bain is opposed to them) that the impressions of the "muscular sense" do not reveal themselves in consciousness as feelings derivable from the movement itself. They maintain, rather, that these sensations are in some way an appanage of the volitional act which occasions the movement; that they are due to the mind's consciousness of its own outgoing energy. And, when Ludwig says of them, "They are not like the organic sensations of muscle, localised by us in the muscle, and looked upon as possessing the characters of a sensation," Professor Bain adds (*loc. cit.*, p. 79): "Ludwig thus appeals to our consciousness as presenting the feeling of muscular energy in a characteristic form, and distinct from the feeling of muscular pains. And in this he seems to be right; for, if consciousness be a safe guide in the matter, we should say that, in the case of a voluntary effort, the feeling is as of power going out of us, and not as of a surface of sense stimulated by an external agent, and transmitting an impression inwards to the nerve-centres.*" Notwithstanding this, however, it does appear, from the note at page 99, that Professor Bain believes there is some feeling of the amount of contraction of a muscle "bound up with our sensibility to movement".

What, then, are we to think of Professor Bain's exposition of the "feelings of movement", as a distinct class of sensations differing materially from the sensations of the five senses, and corresponding with those which "are often regarded as proceeding from a sense apart, a sixth, or muscular sense"? We can only say, after a careful analysis, it seems absolutely certain that he has included under this one heading things which it behoved him to have kept distinct and separate; that very many of those sensations which he seems to consider derivable through an active mode of sensation or "muscular sense", are obvi-

* But, whilst Professor Bain expresses this opinion in the note at page 79, and there apparently agrees with Ludwig and Wundt, in the body of the work, as we have seen, he almost uniformly speaks of the "feelings of movement" as belonging to a distinct class, corresponding with what has been spoken of as pertaining to a sixth sense.

ously not so, and can be resolved at once into modes of passive sensibility; and, therefore, that the philosophical theories which he hangs upon his supposed facts—on the supposition that those are active modes of sensibility which we have shown to be passive—having lost their former props, must find other support, if they are not to fall to the ground. For, in accordance with his philosophical views, he wishes to bring out prominently the “great antithesis of movement and sensation throughout the whole mental system”; and he dwells upon “the total opposition of nature between states of energy exerted and states of passive stimulation”. If, therefore, he could have shown that this psychological distinction had its root in some physiological difference; that our feelings of movement were even totally different from our passive sensibilities; that they were what we may call *active* modes of sensibility, whose existence was dependent rather upon the action of the motor nerves than upon that of sensory nerves,—then his theories would have seemed to derive an additional value and completeness. But we trust that Professor Bain will see that he has not been adopting the most approved methods, when he includes under one head positive sensations which are undoubtedly purely passive, with other sensations presumed to be different and of a so-called “active” nature; when he treats almost entirely of these ordinary passive sensibilities, though he gives his readers reason to believe that he is speaking of a peculiar kind of “active” sensibility; and then, applying the knowledge derivable in great part, if not entirely, through our passive modes of sensibility, on the erroneous supposition that it has been derived through the supposed “active” mode of sensibility, he comes to the conclusion that there are two distinct states of consciousness—an *object* attitude, in which “we are not self-conscious, but are engaged in knowing certain purely object facts, called force, extension, etc.”; and a *subject* attitude, answering to consciousness in its ordinary acceptation. If there be good philosophical reasons entitling Professor Bain to make some such distinction, I venture to think he must do it upon somewhat different grounds from those which he has brought forward.

I maintain, therefore, that all the information which Professor Bain considers to have been revealed to us by the activity of our locomotive organs, has been derived from modes of passive sensibility (occasioned, it is true, by this activity), and from inferences which have gradually been built up upon these. But, as it is desirable that there should be as little doubt as possible upon this important point, I will endeavour to show what additional evidence may be obtained from a rigid inquiry into the nature of the stages by which a complex volitional movement is brought about.

In voluntary movements, whether simple or complex, there are two distinct classes of nervous action involved. There are the cerebral nervous action, and the spinal nervous action; and we must determine accurately what is the province of each. Speaking generally, under the first head comes (1) the cerebral incitation to the movement—the *volition*; and, under the second head, the immediate execution of the movement by means of properly co-ordinated muscular action; this execution being supposed to be essentially dependent upon (2) the co-ordinating functions of the cord and (3) the guiding influence of the “muscular sense”.

1. In our inquiries upon this point, we must bear in mind that in Voluntary acts we have not merely to account for the production of a movement, but of a movement of a certain kind, in which the action of each set of muscles brought into play is duly regulated so as to lead to the exact result desired. And, seeing that the volition or desire to bring about such and such movements is purely cerebral in its origin, so we are bound to admit that such qualities of movement as are contained under this head must also depend upon cerebral influence. Hence the strength, the continuance, the rapidity, and the direction of movements, are variable according to the precise nature of the cerebral incitation or volition. As Jaccoud says, “The strength of the movement is regulated by the strength of the initial motor impulse; the extent depends in reality upon the same influence; the rapidity results from the more or less rapid succession of voluntary impulses; and the direction is determined by the voluntary localisation of the incitation upon certain groups of muscles.” Then it is important to recollect also that, in the execution of a complex movement, any alteration that we may desire to bring about, in respect of any one of these volitional qualities, is, by the mere change in the volition itself, immediately effected with reference to the movement as a complex whole. Jaccoud illustrates this as follows: “I am walking, and then I wish to walk more quickly. Hardly have I conceived the desire before the mode of walking is changed; it has become, in short, more rapid. This intervention of my will manifests itself, therefore, by a change in the movement of locomotion as a whole. This change is the final result of a series of partial modifications which have been brought about in the original movement: this is incontestable. But I have not needed a parallel

series of volitional acts; a single volition has sufficed. I have willed to walk more quickly, and I have then walked more quickly, without knowing anything, without even requiring to know anything, of these intermediate modifications” (*loc. cit.* p. 594). In the same way, alterations in any one of the other volitional qualities of a complex movement are found to have direct bearings upon the movement as a whole. These seem to be the principal facts that should be mentioned with regard to the mere volitional act; and I am quite disposed to agree with Landry when he says, in opposition to the views of several physiologists previously mentioned, that the volition itself includes only an incitation to a specific kind of movement, and that we must execute this movement in order to become acquainted (inferentially) with the quantity of nervous action brought into play. The feeling of expended energy, therefore, by which we obtain our ideas of resistance, and of an external world, is not contained, as we think, in the volitional act itself, but is derived from the moving organs themselves during the actual accomplishment of movements. But here Landry and I part company. He says that the feeling of expended energy and the knowledge of the degree of contraction of the muscles is the peculiar and special revelation of the muscular sense; whereas I say that this feeling of expended energy is dependent upon our purely passive sensibilities, from inferences dependent upon our tactile sensations, upon sensations from our joints, and upon sensations of the passive kind from our muscles themselves.

2. But besides these *qualities* of the movement which are determined by the volition, we have to consider the execution of the movement itself as a compound of several simple movements, brought about by the simultaneous and successive contractions of different muscles, which are perfectly harmonious and constant in their mode of action. This machine-like precision of action—the result of what is usually known by the name of *co-ordination*—is now admitted by most physiologists to depend upon certain pre-established, though gradually acquired, nerve-connections between the different elements of the spinal cord. The movements are machine-like, inasmuch as they depend upon certain organic combinations in the spinal cord, and after these connections have been formed the will interferes no more with them; the movements ordinarily take place in a definite manner, and the will qualifies their execution only. It requires a special exercise of mental power, in fact, in order to execute certain complex movements in a way different from that which has become habitual. But in these cases, as well as when we are learning to execute a new complex movement, we give no attention whatever to the muscles by which the movement is effected—the states of these do not fall within the scope of our consciousness; in our tentative efforts we think only of the movements themselves—how to combine the more simple, so as to produce the more complex. The kind of movement produced is evidently dependent upon the *distribution*, in the medulla and spinal cord, of the volitional impulse; and, in a complicated motor act, its incidence upon particular groups of cells, which are the organic representatives of certain potentialities for simple movements, gives rise to the production of the complex movement. The more frequently such a complex movement has been executed, the more completely may we suppose these various groups to become bound together into one system by connecting fibres, and the more possible is it for the movements which they represent to occur in the most thoroughly automatic manner, and without the least need of cerebral intervention. The mechanism of co-ordination is, therefore, purely spinal. This fact was fully recognised by Volkmann (Art. “Nervenphysiologie” in Wagner’s *Handwörterbuch*, 1844) even five and twenty years ago, as appears from the following quotation: “The physiological accomplishment of movements has nothing to do either with consciousness or with unconsciousness, for the mind has not the least notion of the details of this operation; and even in voluntary movements it knows nothing concerning the nerves or the muscles by the intervention of which the process is accomplished. In fact, the mind does nothing in this case but give the incitation; and if this incitation has for an effect any co-ordinated movement, it is altogether simply because the organ which receives the incitation is arranged in such a fashion that it necessarily produces a co-ordinated movement.” Precisely the same views as these were also expressed, at about the same time, by Arnold and Müller.

3. Thus the work of co-ordination is entirely spinal and organic; the movement itself depends upon the spinal cord, though its particular qualities of force, rapidity, etc., are dependent upon the cerebral or volitional influence. The cerebrum may, therefore, also be said to exercise a kind of co-ordination—it co-ordinates or adapts the movement which is organically represented in the spinal cord, so as to make it accord qualitatively with the aim conceived. But in order that the cerebrum may exercise this power, it seems perfectly obvious that it should be instructed from moment to moment as to the qualities of the movement actually produced, so that it may know whether to continue in its present mode of action, or whether to vary the quality of its volition, in

order better to attain the desired end. Now, according to Jaccoud, the cerebrum obtains these necessary guiding impressions from different sources. He says: "These indispensable notions the brain obtains directly through the sense of sight; or, instead, it deduces them indirectly from the instructions which reach it as to the situation of the parts which move, and the condition of the contractile organs which move them; these instructions are furnished by impressions through the muscular sense, and through the sense of touch."* The sense of sight is what we chiefly rely upon in early years, and in acquiring new movements generally; how long it is before a person learning to play upon a musical instrument can do without the aid of this guiding sense. At last, however, his tactile sense, and perhaps also his "muscular sense", has become so educated that he is able to do without guidance from the sense of sight; and, as a rule, he does without this primary aid as soon as the execution of the movement has become perfectly easy. Jaccoud calls the second mode of appreciation indirect, because it does not, as in the case of the sense of sight, depend upon a simple perception of transmitted sensations, but upon an interpretation of sensations. As he says (p. 601): "The sensorium requires, as a preliminary, to have learned the relations which unite the various conditions of the muscles or of the tactile organs to the different sensations perceived; it is only at the termination of this apprenticeship that it can conclude from the sensation perceived as to the statical or dynamical conditions of the parts whence the sensation springs. This education proceeds correctly, by means of the direct appreciation through the sense of sight, thanks to which the individual can compare at each instant the movement effected with the sensation perceived." After this preliminary education has been finished, the knowledge so acquired becomes as available and as efficacious as that derivable from the sense of sight. It can be brought into action also with just as much rapidity and exactness, so that the sense of sight is no longer needed to inform us as to the position of our limbs, and as to the nature and degree of their movements.†

Jaccoud, therefore, thinks that the power which healthy persons enjoy of performing, with facility, movements that are at the same time habitual and complex depends, in the first place, upon the integrity of their "muscular sense", and, in the second, upon that of their sense of touch. Impressions are derived through both these channels, whereby the brain becomes informed as to the amount and kind of movement which it has called into action, and so we learn whether, to obtain the end in view, it is desirable to continue with the same volition, or to qualify it in any way. Jaccoud, in common with other physiologists, thinks that we are conscious of the impressions of the "muscular sense"; and, as we have previously seen, that our power of appreciating differences in weight is dependent upon the exercise of this sense. I have already stated my reasons for rejecting this opinion, and have endeavoured to show how, in reality, these estimations are inferences based upon previous sensory impressions of the passive kind—upon impressions emanating from the skin, from the joints, and from the muscles themselves, so that, in my opinion, there are no conscious impressions derivable through the "muscular sense." This, as I think, is not to be considered as an appanage of the intellect, but rather as an unconscious organic guide in the performance of voluntary movements. Why, it may be asked, do I not, as Trousseau has already done, deny its existence altogether? And to this I should reply by saying, Although there is no evidence to lead us to believe that we derive any conscious impressions through the intervention of this so-called "muscular sense", there is evidence to shew that the brain is assisted in the execution of voluntary movements by guiding impressions of some kind, which, whilst they differ from the impressions producible by means of the ordinary cutaneous and deep sensibility, may differ still further

from these, owing to the fact of their not being revealed in consciousness to all. How, unless we grant something of this kind, are we to account for some of the phenomena of disease? How can we account for the phenomena observed in such a case as that recorded by Dr. Bazire, and in many others of a similar kind, where all the modes of ordinary sensibility being unimpaired, the patient is unable to execute voluntary movements when the eyes are closed, but can execute them as perfectly as ever under the guiding supervision of the sense of sight? There is clearly a loss of something in these cases, of a something which serves as a guide in the execution of voluntary movements, but whose absence can be compensated for by the supervision of the visual sense; and this is, in great part, the meaning which physiologists attach to the functions of the "muscular sense." So much, I think, we are compelled to grant; but my position is that the impressions of the muscular sense are unconscious impressions, and that the conscious impressions which have usually been stated to fall within its province are really derivable from modes of ordinary cutaneous and deep sensibility. These unconscious impressions of the "muscular sense", travelling to the cerebellum or the cerebrum, would be almost exactly comparable with other unconscious impressions which pass from one point of the spinal cord to another—such impressions, as in all reflex acts depending alone upon the spinal cord, must pass from certain sensory nerve-cells in the posterior cornua (whose afferent fibres emanate from the portion of the skin excited) along what has been termed "an intermediate system" of fibres (see Jaccoud, p. 100) to certain motor nerve-cells, the excitation of which, by this unconscious impression, brings about the accustomed reflex action. But, as we have seen, the "muscular sense" is called into operation as an aid to the process of cerebral co-ordination, and is not concerned in the work of spinal co-ordination. The "muscular sense" furnishes those unconscious impressions by which the quality and maintenance of the volitional act is determined with the view to the accomplishment of a definite end, so that the anatomical structures concerned are related to the process of cerebral co-ordination of movements in precisely the same way that the system of intermediate fibres are related to the purely reflex co-ordinated movements which take place through the instrumentality of the spinal cord alone. In the process of cerebral co-ordination, therefore, one set of impressions, those of the "muscular sense", are completely monopolised, whilst the impressions of touch or common sensibility are made use of in the process of spinal as well as in that of cerebral co-ordination, only with this difference, that the impressions of touch which enter into the evolution of purely reflex spinal co-ordinated movements are impressions impinging upon the spinal cells, and therefore such as do not arouse our consciousness, whereas those similar impressions of touch which in other cases pass onwards from the spinal cells to the brain do reveal themselves as conscious states. In order that that education should take place which I have before spoken of as growing out of the associations built up between the visual and tactile impressions derivable from our various movements, it was essential (if desirable that we should be able to execute movements without the constant supervision of the sense of sight) that some of the ordinary impressions which are to serve as the monitors for the regulation of our volitions should be conscious impressions; whilst it would seem also more than desirable that the principal guides which are to be made use of throughout life should be impressions which did not reveal themselves in consciousness, and which, therefore, did not allow all the details connected with the action of our muscles to disturb our processes of thought. Precisely such unconscious impressions are those which, as I conceive, pertain to the activity of the so-called "muscular sense."

[To be concluded.]

* In its widest sense.

† When we commence a movement, we initiate it with certain predetermined qualities of force and extent; and this, of course, is simply a result of our past experience and education. I know that certain objects have hitherto given me certain impressions of weight when I have previously handled them, and therefore my previous education now enables me, when I see such an object again and desire to handle it, to give the volitional act its necessary qualifications. This power has been variously termed "*l'instinct locomoteur*", "*conscience musculaire*", and "*l'aptitude motrice indépendante de la vue*", and has been made the subject of much mystification, though it is a simple result of education, and should not be confounded with the functions of the "muscular sense." When I see a simple bundle of wool on a table, as a result of previous education I can at once nearly accurately determine what ought to be the quality of the volition necessary to enable me to raise it. As a result of this education, I am enabled to initiate a movement deemed appropriate. But supposing in the case just cited, that the supposed simple bundle of wool was not a simple bundle, that it contained a heavy leaden weight in its centre, then my initial volition would have been inadequate, I should have been deceived, and the impressions that I then received from my sense of touch and from my muscles would have instructed me that a stronger volitional effort was necessary; and it is in this way always that the sense of touch and the muscular sense are supposed to intervene. By this supposed locomotive instinct, we know, as Jaccoud puts it, *what force we ought to employ*, whilst by ordinary sensibility and the "muscular sense" we are taught *what force we have employed*.

PURPURA IN CHILDREN, AND ITS TREATMENT BY SECALE CORNUTUM.—Dr. Bauer describes two forms of infantile purpura; and states in the *Deutsche Klinik*, No. 35, that he has had frequent opportunities of treating this affection in young patients. The most common form is the purpura simplex, which occurs in suckling infants and young children belonging to the rich as well as the poor classes of life. This affection is generally very slight, and seldom requires any special treatment. The second form, purpura hæmorrhagica, which is much more severe, is characterised by hæmorrhages from the nose, lungs, intestines, and womb. For this affection, which is generally very obstinate and resistant to remedies hitherto proposed, Dr. Bauer has administered, with marked and speedy results, ergot of rye, either as powder or in an infusion. The usual dose is from eight to ten grains, given, according to circumstances, once, twice, or thrice in the day. Under the influence of this drug, hæmorrhage is arrested, and the effused blood absorbed in from one to three days, or, at the very latest, by the sixth day. The use of ergot does not, however, guard against relapses.—Schmidt's *Fahrbücher*, No. 1, 1869.