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PART 1.—ORIGINAL ARTICLES.

Reflex, Automatic, and Unconscious Cerebration: A History and a Criticism. By THOMAS LAYCOCK, M.D., &c. Physician in Ordinary to the Queen for Scotland, and Professor of the Practice of Physic and of Clinical Medicine in the University of Edinburgh.

An Essay in the Journal of Mental Science for October, 1875, entitled, "Can Unconscious Cerebration be Proved?" by Dr. Ireland, Superintendent of the Institution for the Education of Imbeciles at Larbert, ends thus:—"In any case the theory of 'unconscious cerebration' derives no support from physiology. It is a child of the old metaphysics, to be brought forward and repelled by the study and analysis of mental operations, cognisable by internal examination."

I.—I do not understand, whatever meaning may be attached to terms, how it is that the theory controverted derives no support from physiology; but I clearly see that the method recommended is that of speculative philosophy, which leaves the brains and their doings, or cerebral physiology, out of consideration, and depends upon the abstract process termed "internal examination." The question as to method thus raised involves an answer to two other questions—viz. (1), Do all men use their brains in thinking and doing, so that, without brains, they can neither think nor do? And (2), if this be answered in the affirmative as a fact of experience, then is consciousness a cause, or is it a coincident and a result, of these changes in the brain-tissue upon which all manifestations of mind depend, and itself due to an "immaterial" cause?

In the year 1837, when I first turned my attention to the phenomena of mesmerism and of cerebral hysteria with a view to practical results, it was the general opinion, in this country

at least that consciousness was the cause of all those changes with which it is associated. Mind considered as a cause and consciousness were held to be identical. This doctrine I controverted. Many of the old school denied, too, that the brain had any essential connection with the intellectual powers. Sensations might have their seat there, but the reason was independent of brain-function. This doctrine I also controverted.

Dr. Ireland also opens his essay with another statement. "Unconscious cerebration," he says, "is regarded as so important a discovery that two well-known scientific men have contended for the priority of its publication." I cannot doubt that Dr. Carpenter and myself are here referred to. I therefore think it right to disclaim not only the paternity of the phrase "unconscious cerebration," but also of much of what is included under that phrase; and not merely because, like the phrase, it is Dr. Carpenter's, but because it is opposed to my views. And I would add, as only an act of justice to Dr. Carpenter, that in my opinion he has honestly endeavoured on various occasions to indicate our respective shares in the doctrine, although he has not, I think, been altogether successful. These acknowledgments include the fundamental principles upon which certain portions of Dr. Carpenter's views as named by him are based, together with their chief applications to the problems of mental philosophy and the needs of medical science and art. As to certain other principles, I differ entirely from Dr. Carpenter; neither do I agree with him as to his method, which includes too much, I think, of "the old metaphysics." Dr. Ireland's whole business as a physician is with brain-structure and brain-function; and being an intelligent thinker, although evidently of the old school, and a careful observer in his own department, I may assume that he is an example of the difficulties which men of culture find in understanding and accepting the theory. As to the doctrine of causation implied in the phrase "unconscious cerebration," and as to my share in its development, perhaps no one has manifested more strikingly these difficulties than Dr. Carpenter has from the date when he first took cognisance of my researches. These difficulties are due to two circumstances; firstly, the ambiguous meanings attached to phrases and terms derived from the "old metaphysics," and, secondly, to a too superficial perusal of the works in which my views are set forth. For these reasons, it happened, as I shall show, that Dr. Carpenter

not only formerly remained in ignorance of the exact bearings on mental science and practice of my theory of cerebral reflex function, but even still imperfectly comprehends it in regard to causation. It is with the hope of obviating these difficulties for those who are seeking after truth as to causation in mental philosophy, that I propose to trace the development of the doctrines comprised in the phrase "unconscious cerebration," and show how the use of ambiguous terms has hindered the progress of exact knowledge as to the nature of mind and its manifestations.

II.—The first of these ambiguous terms is anatomical. Dr. Carpenter uses the word *cerebrum* in its derivative, cerebration, (*quasi cerebrationem*) to denote the *convolutions* of the *cerebrum* exclusively, whereas anatomists (without exception, I think) use it to denote both the *hemispheres* of the brain and their connexions, as the *crura cerebri* and pineal gland, and the ganglionic masses contained within them, viz., the *corpora striata*, optic thalami, fornix, *corpora albicantia*, &c., as well as the convolutions. Again, out of these and other ganglionic masses, as the olfactory ganglia, Dr. Carpenter constitutes another anatomical system, which he terms the *sensori*—more correctly the—*sensorio-motor* system, because he is of opinion it constitutes a *sensorium commune*. I am not aware that this system has had any strictly anatomical demonstration, and I may here say, once for all, that the physiological hypothesis seems to me to be exceedingly doubtful, if not wholly unproved.

The word "cerebration" was first used by Dr. Engledue, of Plymouth, on 20th June, 1842, in an address to the Phrenological Association, to denote a certain mode of functional activity of the *cerebrum*, according to the anatomy of Gall, who localised the organs or mechanism of the mind in the convolutions. The doctrines which Engledue expounded on that occasion acted like an explosive on the Association, and broke it up. He affirmed that phrenologists were in error in propounding that the brain is the organ of the mind, inasmuch as there is no such thing as mind. The brain is simply a viscus with its own proper functions, like the liver and kidneys. His doctrine was a true materialism of the hylo-zoic or atomic class. A passage will best elucidate this meaning of "cerebration"—

"We contend that mind has no existence—that we have to consider matter only. What is organised matter? Merely a collection of atoms, possessing certain properties, and assuming different and deter-

minate forms. What is brain? Merely one kind of organised matter. What do we mean by cerebration? The functions of the brain—one of the manifestations of animal life resulting from a peculiar combination of matter. The varied changes of form which this matter assumes give rise to the various manifestations of cerebration in the different tribes of beings, and the varied changes of cerebration in the same being originate in molecular alterations, merely other expressions of a new condition.

“Cerebration, then, expresses the manifestation of a series of actions resulting from the properties possessed by a particular portion of the organism (brain) when acted upon by appropriate powers. In the same way as organism generally has the power of manifesting, when the necessary stimuli are applied, the phenomena which we designate by the term life—so, one individual portion (brain) having peculiar and distinct properties, manifests, on the application of its appropriate stimuli, another species of action which we propose to call cerebration.” (Engledue’s Introductory Address, *Phrenological Journal*, Vol. xv., 1842, p. 295.)

It thus appears that the term *cerebration*, as first used, denoted two conclusions—first, that the cerebrum is put into functional activity by appropriate stimuli, and, secondly, that this is all; for mind, considered as a cause or an energy, has no share either in the development of the mechanism, or as to the way in which appropriate stimuli act thereon. The fallacy of Engledue’s views lies obviously in the word “merely”—when he says “That organised matter is *merely* a collection of atoms.” In arriving at this conclusion, he followed a common but very fallacious method, according to which the inquirer takes his own incapacities to be the measure of the capabilities of all others, and then concludes from his ignorance of a thing to its non-existence. Thus Engledue says—“The ‘why or how’ such a form of matter is capable of manifesting such peculiar function we cannot explain,” meaning by “we” that he cannot; and then, after thus confessing his ignorance and incapacity, he denies that there is any other cause than the atoms themselves. A little further consideration of the “order of nature” would have convinced him that the same brains which helped him to a knowledge of atoms (things wholly beyond observation) would also have helped him, when rightly used, to a knowledge of energies, things much more demonstrable than atoms.

III.—I shall not consider the ambiguous uses of the word “unconscious” and of other metaphysical phrases, until I have more clearly shown how the doctrines of unconscious cerebration arose and were developed. Dr. Carpenter gave a brief

history in the "Quarterly Review" of October, 1871, in an essay entitled "On Spiritualism and its recent Converts," which I shall examine.

"As far back as the year 1844 a very important memoir was published by Dr. Laycock (now Professor of [the Practice of] Medicine in the University of Edinburgh) on the reflex action [function] of the brain, in which he most distinctly showed that involuntary muscular movements take place in response, not merely to sensations, but to ideas; and not merely at the prompting of ideas actually before the mind, but through the action of the *substrata* left by past mental operations. Thus, for example, the convulsive paroxysm of hydrophobia may be excited not merely by the sight or the sound of water, but by the idea of water suggested either by a picture or the verbal mention of it. But as Dr. Laycock did not at that time recognise the essential distinctness of the *sensory ganglia* from the cerebrum, which—being so obscurely marked in the brain of man as to be commonly overlooked—can only be properly appreciated by the student of Comparative Anatomy, he confounded together the two classes of actions of which they are the separate instruments, and his views did not receive the attention they merited. The doctrine of the reflex action of the sensory ganglia having been long previously taught by Dr. Carpenter under the title of 'Sensory-motor activity,' he was subsequently led, by Dr. Laycock's reasoning, to see that it might be extended to the cerebrum proper. And on the 12th March, 1852, some months before the Table-turning broke out, he delivered a lecture at the Royal Institution on what he termed the *Ideo-motor* principle of action, which consists in the involuntary response made by the muscles to ideas with which the mind may be possessed when the directing power of the will is in abeyance, considered as the 'reflex action' of the cerebrum proper. 'This Ideo-motor principle,' said Dr. Carpenter, "finds its appropriate place in the physiological system, which would, indeed, be incomplete without it. And, when it is once recognised, it may be applied to the explanation of numerous phenomena which have been a source of perplexity to many who have been convinced of their genuineness, and who could not see any mode of reconciling them with the known laws of nervous action. These phenomena have been clearly proved to depend upon the state of *expectant attention* on the part of the performer, his will being temporarily withdrawn from the control of his muscles by the state of abstraction to which his mind is given up, and the *anticipation* of a given result being the stimulus which directly and involuntarily prompts the muscular movements that produce it.

"This doctrine was at once accepted by many of our highest physiological authorities, so that when Professor Faraday was called upon to explain the mystery of table-turning (which had not then been attributed either to 'diabolical' or to 'spiritual' agency, but was popularly

supposed to be due to electricity), he was able not merely to prove by the ingenious 'indicator' he devised, that the movement is really and solely due to the muscular action of the operators, but to refer for a scientific *rationale* of that action to a physiological principle distinctly formularised more than two years previously, and less precisely enunciated nine years before." (*Spiritualism and its Recent Converts*: Quarterly Review, Oct., 1871, pp. 310, 311.)

It will be observed here that I have had to correct the title given to my Essay, and alter the word "action" to "function"—a most material difference when investigating causation. This I shall specially notice shortly.

A primary step in questions of priority is to fix dates accurately; as to these, we have the first illustration of one of the causes just mentioned of Dr. Carpenter's difficulties. Faraday wrote to "The Times" on the 30th June, and to the "Athenæum" on the 2nd July, 1853. In his letters he distinctly points out that the movements of the tables were then attributed to supernatural and spiritual agencies, and laments, in forcible language, the ignorance and folly of the notion.* Again, it is not clear what Dr. Carpenter means exactly when fixing the date of his physiological explanation of the true causation at "nine years before;" whether the nine years date from the reading of his paper in March, 1852, or from the experiments of Faraday in 1853; but taking the latter date (as seems to be meant), the year 1844 is that in which Dr. Carpenter less precisely enunciated the explanation in question. I think that "nine" must be a misprint, for in that year, as will shortly be seen, although he was strongly advocating his "sensori-motor system," yet he nevertheless found that "everything beyond this was mysterious and incomprehensible."

Again, how far Dr. Carpenter is accurate in fixing the year 1844 as the date when my views were first promulgated, will be best shown by the following introductory paragraph from the Essay to which Dr. Carpenter refers.†

"Four years have elapsed since I published my opinion, supported by such arguments as I could then state, that the brain, although the organ of consciousness, was [is] subject to the laws of reflex action, and in this respect it did [does] not differ from the other ganglia of

* "Life and Letters of Faraday," by Bence Jones, vol. ii., p. 304.

† *On the Reflex Function of the Brain*. Read at York, before the Medical Section of the British Association for the Advancement of Science on 28th September, 1844. With an Appendix.—*British and Foreign Medical Review*, January, 1845, p. 298.

the nervous system.* I was led to this opinion by the general principle that the ganglia within the cranium, being a continuation of the spinal cord, must necessarily be regulated as to their action on external agencies, according to laws identical with those governing the functions of the spinal ganglia and their analogues in the lower animals. And I was confirmed in this opinion by finding, after the investigation and collocation of known facts, that observations and arguments like these satisfactorily adduced in proof of the reflex function of the spinal ganglia may be brought forward in proof that the cerebral ganglia have similar endowments."

Although the subject was at this date thus limited, the views I had advanced four years previously were of a much more comprehensive scope, as is expressed in the following passage from the chapter referred to. After examining certain generalisations, I say:—

"The importance of these doctrines is apparent. They corroborate the truth of the proposition already laid down, that the cranial ganglia, although the organ of consciousness, are subject to the same laws as those which govern the other ganglia, the diffused nervous system of animals, and the vital mechanism of plants."—(Treatise on the Nervous Diseases of Women, 1840, p. 107.)

From these extracts it will be seen that it was in 1840, and not in 1844, that I extended inquiry as to mechanism and energies beyond the comparative anatomy of the vertebrates, so as to include not only the nervous system of all animals, but also the vital mechanism and energies of plant life. No doubt Dr. Carpenter was led, in 1851, by investigation into the phenomena of mesmerism, to the adoption of the doctrine of the reflex function of the brain, but I also was led in 1837-38 to a like investigation. At that time I was attached to the York County Hospital as house surgeon, and had opportunities of investigating the phenomena both clinically and experimentally, and more especially as manifested in women under the various forms of cerebral hysteria. The results of these researches were communicated from time to time to the "Edinburgh Medical and Surgical Journal," 1838-39, and conjointly are equal to an octavo volume of more than 200 closely printed pages. My Treatise on the Nervous Diseases of Women

* This date refers to 1840, when my "Treatise on the Nervous Diseases of Women," was published, in which there is a chapter (p. 105) headed, "The Instinctive Actions in Relation to Consciousness: the Brain subject to the laws of Reflex Action."

(1840) was, as stated by the preface, a second edition of these essays.*

IV.—So much as to dates; next as to the *method* of inquiry. Dr. Carpenter is of opinion that the desired knowledge is to be attained by a study of the comparative anatomy of the nervous system, more especially of vertebrates, and hints that I did not appreciate the truth of the principles upon which his sensori-motor system is founded, because I was deficient in that knowledge. The obvious objection to this method is, that the inquirer never can know, as facts of observation, what are the states of consciousness of lower animals when inquiring into its relations to their mechanism. True it is, that for the sake of comparison with the mechanism and energies of man that knowledge is needed; but it is an error of inference on the part of Dr. Carpenter that I had not the knowledge. This error is, however, of little importance. It is, perhaps, sufficient to say that, like Dr. Carpenter himself, I studied Comparative Anatomy at University College under “the English Cuvier”—Robt. E. Grant—and was a diligent reader of Dr. Carpenter’s “Principles of Human and Comparative Physiology.” But in the course of my inquiries (after 1845) I came also upon the “Zoologie Philosophique,” of Lamarck—an important forerunner of Darwin, who showed not only the mechanism of living things, but the processes by which that mechanism is both constituted and moved. It was also by the aid of such generalisations as those of Wolff, Goethe, and von Baer, that I was led to use more firmly than I otherwise should have done the hypothesis of evolution, to which I added that of reversion as the law of both mental and general pathology. In the essay published in July, 1839 (but which was in the hands of the editor of the “Edinburgh Medical and Surgical Journal” during the previous autumn), will be found the outline of that method laid down, and the law of evolution taken as the guide to inquiry as follows:—

“20. If we would obtain a large and definite knowledge of the action of force [as motion] upon matter and intelligence, in exciting the phenomena of life and thought as displayed in man, we must

* By T. Laycock, House-Surgeon to the York County Hospital: A Selection of Cases presenting Aggravated and Irregular Forms of Hysteria, with Analysis of their Phenomena. *Edinburgh Medical and Surgical Journal*, Jan., 1838. Hysterical Ischuria, April, 1838. Hysterical Hæmorrhages and Nervous Affections and part of Analysis, July, 1838. Analysis continued, October, 1838. Analytical Essay, July, 1839.

examine the law of its action [*i.e.*, of force as motion] as exhibited both in every living organism and in the molecular changes of inorganic matter. A thousand circumstances assure us that between these last and the highest efforts of the human intellect, there is a continuous chain of phenomena, although we have been unable to follow it link by link. These links are so continuous between certain vegetables and animals of the lowest class that naturalists have been unable to decide whether the organism should be placed in the animal or the vegetable kingdom."—(p. 9, *op. cit.*)

Here, then, is a statement that we have molecular physics and energies as vital chemistry to deal with evolutionally, in our investigation into life and thought and will, and that the law of *continuous* evolution is the guiding principle. This is followed by a short exposition of the evolutionary mechanism, *i.e.*, the evolutionary anatomy of the nervous system.

From these facts it is clear, I trust, that there has been a fundamental difference *ab initio* between Dr. Carpenter and me as to method; for although he dealt restrictedly with the mechanism evolutionally, in so far as the nervous system is concerned, through its comparative anatomy, on the other hand he at that time left wholly out of consideration the evolutionary anatomy of the hemispherical ganglia, and therefore with the evolution of the vital energies or forces into mental activity. How little his method served him, and many others who followed this method, in elucidating brain function, is shown by what Dr. Carpenter had to say in regard to its results at this same date:—

"The complexity of the operations of the *mind*, and the impossibility of deriving from the study of the lower animals any assistance which can be relied upon in their analogies, have hitherto been a complete bar to the successful investigation of them as portions of the nervous system. *It is, as yet, quite uncertain how far mental acts are dependent on or connected with any changes in its condition.*" (Principles of General and Comparative Physiology. By W. B. Carpenter, Lond., 1838, p. 454.)

In the last paragraph Dr. Carpenter must only be understood as witnessing to his own convictions; the school of Gall and Spurzheim was then in full activity with a principle just the contrary. His was the doubt expressed then, as now, by "the old school of metaphysics," so that it is a matter of course that Dr. Carpenter should use the phrases and terms of that school, and this as much as ever in his latest work, "Mental Physiology."

The method I followed in working out this unsolved problem was, in fact, to examine the analogies which Dr. Carpenter stated in 1839, in the extract just given, to be a complete bar to the exact study of cerebro-mental phenomena. But this I did by investigating sequences and coincidences, as well as differences and resemblances. In doing this I took the sequences and coincidences included under "spinal reflex function" as a starting point, and endeavoured to show that the actions or muscular movements under investigation exactly resemble, as to the *condition* under which they occur (or, in popular phrase their causes), the class of "reflex acts" and actions, whether they are named sensational, ideational, volitional, intellectual, instinctive, or involuntary; and are due to conditions or functions of brain or of nerve-centres, which conditions coincide with other conditions of brain upon which the states of consciousness named sensation, ideation, volition, will, or instinct depend.

It is, therefore, as to "the order of nature" in causation that Dr. Carpenter misunderstood me. I held that consciousness *per se* is not a cause, as taught by the "old metaphysics," but a coincidence—although as to evolutionary life an essential coincidence; and, as such, the manifestation of an "immanent" energy, the cause of both life and consciousness.

It was as to this principle and its applications to certain departments of Mental Science and the practice of medicine that I made the reclamation alluded to. When with this view of causation I formally extended the doctrine of spinal reflex function to the brain, I certainly took care to state it as explicitly as language allowed. After premising a summary of spinal reflex phenomena in their relations to coincident sensations, which were then admitted (sensation denoting a state of consciousness of some kind—no matter how defined), I pointed out that all other states of consciousness, including ideation and volition, are not causes but coincidences of the acts, and themselves due to cerebral conditions or functions excited reflexly.* The actions occur, to use the words of Prochaska, "*Mens conscia vel inscia.*" On the other hand Dr. Carpenter, noting a constant connection of states of consciousness named sensations with certain combined muscular movements, concluded that the sensation is an antecedent and not a coincident of the acts in question. In this way he considered these states of consciousness to be causes.

* "Brit. and For. Med. Rev.," vol. xix. (Jan., 1845), p. 299, 300.

Now this is precisely what was then the teaching of Alison and John Reid, as well as of Dr. Carpenter, and had been for a long period before that date of Whytt and others. It was, in fact, a part of the universally current opinion that consciousness in every form is the cause of certain movements. My object was to show that herein the coincident was put for the antecedent. It follows, therefore, that in the "Quarterly Review" for October, 1871, Dr. Carpenter states precisely the contrary to my view when he affirms that I "showed involuntary muscular movements take place in response to sensations, and not merely to sensations, but to ideas." This is probably one of the propositions which Dr. Ireland thinks to be a child of the old metaphysics, and which it certainly is.

V.—But another source of error is to be found in Dr. Carpenter's ambiguous use of the phrases *reflex action* and *reflex function* in relation to the word sensation. As used by Hall, and by all physiologists since his time, reflex function wholly excluding sensation as a cause. The phrase was expressly adopted to set forth the doctrine that the class of actions termed reflex are wholly independent of sensation, whether it be considered a cause, or a condition, or a coincidence. When, therefore, Dr. Carpenter says that his doctrine of the reflex *action* (meaning function) of his sensori-motor system had been long previously taught by him, he is again in error, inasmuch as he confounds the conscious state named sensation with reflex function as a cause. This is clearly shown by his own words in the subjoined extract from a letter he wrote to Forbes in November, 1844, after reading my Essay in proof, which Forbes sent to him. The italics in the letter are in the original, thus giving the most conclusive proof of the ambiguity I have described.*

"I am much obliged by the sight of Laycock's paper, which is very much what I expected it to be. The *class of actions* to which he refers I had distinguished in *my first paper* on the subject. By my subsequent investigations I had been led to refer them to the *ganglia* of special sense, which stand in the same relation to the *nerves* of special sense as the segments of the true spinal cord to its afferent

* I may properly remark here, as to this correspondence, that Forbes did not send the letters to me as being "private and confidential," but in his public capacity as Editor of the "Brit. and For. Med. Review," in which my essay was to appear, and with the request that I should point out in what particulars my views differed from those of Dr. Carpenter, with a view to publication with the Essay. I wrote an *addendum* in compliance with this request, which now lies before me, but Forbes did not publish it.

nerves, and which have also a distinct connection with the motor tract of the med. oblong. I did not apply the term *reflex* to them, because I considered it better to restrict that to the actions of the spinal cord. But I pointed out the *immediate dependence of the motion upon the sensation*, which is, in effect, the same thing. Dr. L. refers this class of actions (first distinguished and defined in the paper I allude to) to the cerebral hemispheres, which seems to me to imply an utter ignorance of the Comparative Anatomy of the Nervous Centres. I do not care to enter into a controversy on the subject. *Magna est veritas*, &c.—Yours most sincerely,
W. B. CARPENTER."

In a subsequent letter to Forbes, dated 27th Nov., 1844, Dr. Carpenter entered more fully into the subject, and affirmed the emotional character—that is, as due to emotion—of the convulsive paroxysms of hydrophobia, as follows:—

"I should like to know where he [Dr. L.] had pointed out the *emotional* nature of hydrophobia before my 'Human Physiology,' where it is pointedly stated, and the illustrations given. . . . I had a battle to fight with Marshall Hall, who connected the emotional system with the spinal, and my comparison of tetanus went to prove their distinctness."

The controversy with Hall here referred to arose out of ambiguities precisely like those I have illustrated. Hall fixed the limits of his "true spinal system" at the tubercula quadrigemina inclusive; these and all the nerve-centres below, including those of the cord and bulb, are merely physical centres, with which consciousness has no causal relation whatever; all above are the seat of, and are acted on by, the "soul." Dr. Carpenter, on the other hand, included the tubercula and certain centres of the bulb in his "sensori-motor system." These are not, according to him, the seat of the soul, but of sensation; and "guiding sensations" seated here are the causes of consensual or "sensori-motor" actions. Hall naturally objected to the theories of both the anatomy and the causation, and more especially because the consensual actions, which are the signs of the instinctive feelings and emotions, were also included by Dr. Carpenter in his "sensori-motor system."

Whatever truth there may be in any of the hypotheses, these facts are instructive illustrations (and they might be greatly multiplied) of the misleading influence on physiological research of ambiguous terms and phrases, and more especially of those of "the old metaphysics." That they are thus generally operative is certain. Ten years later

Dr. Carpenter discovered his erroneous conclusions, when, through our common friend, Sir John Forbes, I reclaimed the fundamental principle of "unconscious cerebration," and its chief applications to mental science, at the time Dr. Carpenter claimed them in the fifth edition of his "Human Physiology" (1855). In a most friendly letter to me of date 12th June, 1855, he attributes his misapprehension of my views to the fact that my terms were obscure, because I made use of phraseology that itself required to be learned, and the terms of which do not always bear the meaning that their etymology would suggest. More particularly Dr. Carpenter remarks at this date as to his sensori-motor system :—

"In the second edition of my 'Human Physiology,' which I had completed before the York meeting of the B.A. at which your paper was read, I brought the doctrine of consensual action and the reflex functions of the sensory ganglia into still greater prominence. Up to that time, however, I must fully admit that the idea of reflex action as applicable to the cerebrum had never crossed my mind. I believe that I did not hear your paper read, but first *saw* it in the B. and F.M.R., and I well remember the very puzzled state in which it left me. My first and strongest impression was, that you had *thrown back* the subject by ignoring all that I had tried to do in the disentanglement and explanation of the instinctive actions; that you had erroneously attributed to the cerebrum a great number of phenomena which, being sensori-motor, were [are] performed through the instrumentality of the sensory ganglia, and that everything beyond this was mysterious and incomprehensible."

Further correspondence on the points discussed cleared up Dr. Carpenter's difficulties, and I shortly received a recognition of my claim as follows :—

"I certainly did think when I wrote the note ('Physiology,' fifth ed., p. 554) to which you refer, that the application of the doctrine of Cerebral Reflex Action to Insanity, Dreaming, Delirium, Somnambulism, Hypnotism, Electro-biology, Reverie, &c., was original with myself, and have only *now* discovered, by a reference to your paper (Appendix VI.) that you had yourself distinctly marked out this development of your doctrine. . . . I must say, in my own defence, that neither Noble, Symonds, nor (I think) Forbes expressed the least doubt that *this* part of the subject was fairly mine, as neither of them seemed at all aware that you had made it so clearly your own at the very outset. I shall, of course, alter this passage in my next edition, and only regret that you did not call my attention to it after the publication of the fourth. Of course I should not now speak of myself as having formularised the doctrine of

‘Ideo-motor’ action,’ in any other sense than as having separated it, both anatomically and physiologically, from sensori-motor action. The fact is simply—as I believe that I said before—I did not carefully examine your paper (as I admit I ought to have done) to see what more it contained, when I first began to understand and appreciate its real meaning.”

I subjoin the passage to which Dr. Carpenter refers:—

“VI.—*The Association of Ideas.* Being like the association of movements [consensual actions], the true explanation of the association of ideas is to be found in the doctrine of the reflex function of the brain. The mode of action of the sensory gray matter is strictly analogous to that of the motor gray matter, both with reference to its substrata and the diffusion of afferent impulses through it. Insanity and dreaming present the best field for investigating the laws of that extension of action from one portion of the brain to the other, by which ideas follow each other in sequence. An interesting example for study is now in the Retreat, near York. This person seems to be utterly will-less. He expresses his ideas as they spontaneously arise in associated sequence, the combinations being singularly varied, but traceable to a common root or centre of impulse. Researches of this kind, whether instituted on the insane, the somnambulist, the dreamer, or the delirious, must be considered like researches in analytical chemistry. The reagent is the impression made on [the hemispheres of] the brain; the molecular changes following the application of the reagent are made known to us as ideas. In chemical analysis we know molecular changes [in matter] only by the change in form, refractive powers, and other circumstances induced by the reagent; in cerebral analysis we *feel* the changes or observe their results through the efferent nerves. It is very probable that only in researches of this kind can a scientific spiritualism be established, and through them the link seized that connects the spiritual with the material world.”—(British and Foreign Medical Rev., Jan., 1845, p. 311).

Unfortunately, Dr. Carpenter had not fulfilled his promise as above when I published my systematic work in 1860, so that in the meanwhile the fundamental doctrine of “unconscious cerebration” was attributed to him. This placed me under the imperious necessity of making that public reclamation which I had been most anxious to avoid. I felt that unless I did this I exposed myself to the charge of plagiarising from Dr. Carpenter. I reclaimed, therefore, in an *appendix* to that systematic work.

It cannot be doubted, I think, that Dr. Carpenter gave a correct exposition of the circumstances under which he worked out his share of the problems. Having adopted the theory of

reflex cerebral *function*, its logical application to unconscious cerebral *actions* obviously followed, since the absence of consciousness as a cause is of the very essence of the theory of reflex *actions* of any kind. But it is, I think, equally certain that Dr. Carpenter still held (as, indeed, he still holds) states of consciousness to be causes; for the phrase "ideo-motor" points to the current notion that ideas excite cerebral reflex acts just as sensation excites sensori-motor acts. What he was working out was, in fact, an *anatomical* classification of the mechanism of mind (as he affirms); but this being so, the naming should have been anatomical, and *cerebro-motor* used instead of *ideo-motor*. This would have been in strict accordance with the phrase reflex *function* as used by Hall, who maintained that it was the *function* of the centres he termed spinal to regulate adaptive acts, independently of any states of consciousness whatever, all which with him were causes. Now Dr. Carpenter is so embarrassed by his two-fold use of the phrase and of sensation, that he is unable to account for man's freedom of action, if the "automatic" action of the convolutions be solely considered; he therefore adopted and applied (as we shall see shortly) a doctrine of causation as to free-will of the "old metaphysics."

VI.—There is another set of words and phrases used ambiguously in both cerebral physiology and mental philosophy in connection with the terms reflex function, consciousness, mind, &c. These are the words *automaton*, and its derivatives—*automatic*, *automatism*. The term *automaton* is derived from the ancient Greek word *αὐτοματός*, the primary meaning of which, according to Liddell and Scott, is "acting of one's own will, of one's self." It evidently, therefore, included the notion of a living mechanism having a self-determining power or capability. When it became necessary to name a mechanism which is self-acting in the same sense as living things, and more especially as a man is, that is to say, from some *hidden* apparatus and source of energy such that adaptations of the motions to ends resulted, the name *automaton* (in the neuter) was given to it. In modern times such mechanism shaped and constructed so as to move when in action, like men and animals, are specially *automata*. In this way it is that the term has departed wholly from its primary sense (as all such metaphorical words do), so as to denote a thing constructed to imitate a living being as to form and motion. Gall and others using the word in the sense of a living mechanism of which consciousness is not the motor energy,

applied it to plant-motions; but Descartes pronounced all animals below man in the scale of being to be no more endowed with consciousness than plants—they also are living *automata*. This conclusion followed necessarily from his hypothesis, that not only is consciousness the sole cause of consciously—in the sense of knowingly—adapted acts, but that it is the element which constitutes the soul or mind of man. And since souls cannot, according to this hypothesis, be possessed by brutes, they must necessarily be denied the endowment of consciousness. On the other hand, consciousness was with him not only the cause, but the proof of soul-life. Hence his well-known *dictum, cogito ergo sum*. To connect this hypothetical soul with the living mechanism, it was necessary to fix a central place whence it could act on that mechanism, and thus Descartes selected the pineal gland as the *sensorium commune*. There is a fundamental question to be settled, however, as to this part of the hypothesis—viz., Is there a *sensorium commune*? Is such a thing necessary? Plants are organisms, and seeds are unified potentialities of one thing; have they the analogue of a unifying *sensorium commune* as to mechanism?

Dr. Carpenter's hypothesis of a "self-determining power" peculiar to man is, therefore, similar to that of the Cartesian soul, and, like that hypothesis, needs a central place of consciousness and action, or *sensorium commune*. This is to be found in his "sensori-motor" system, whence originate the reflex actions as involuntary movements, which are due to sensation, and where also consciousness as ideation is experienced; so that that system takes the place of the pineal gland in the Cartesian anatomy. Sensational and ideational involuntary movements he further differentiates as "automatic actions of the body," from the "automatic actions of the mind" which are the automatic processes, included under "unconscious cerebration" that go on in the hemispherical convolutions. The results of these processes he designates "automatic mind," and propounds the hypothesis that this is the normal order of nature in the cerebro-mental activity of lower animals and young children. I subjoin a list of these "automatic actions" from the index to his "Mental Physiology:"—

"Automatic Action of Body: Mechanism of (see *reflex action*)—nervous system; in Ascidian; in Centipede; in Mantis; in *Dysticus*; of spinal cord in Frog; in man; of sensory ganglia; of cerebrum.

Automatic Action of Mind [in chaps. 14 and 16]: In attention;

in succession of thought; in reasoning; in common sense; in judgments; in imagination; in abstraction and reverie; in electro-biology; in somnambulism; in hypnotism; in intoxication (see *children*)."

Looking now to the context for the meanings which Dr. Carpenter attaches to the word *automaton*, and to its derivatives, I find they are two which are widely distinct and different in a scientific sense. By one meaning he denotes a mere mechanical apparatus made to resemble a living thing, but wholly devoid of life and consciousness; by another he indicates the structure of the brain, considered as a mechanism endowed both with life and consciousness, as sensation and thought, and brought into activity by energies appropriate to it, yet not guided by reason, judgment, or "the will." Consequently, since men are so guided, it becomes necessary to his hypothesis of automatic brain-work, that there shall be an energy operative in and on the brain which is distinct from, and independent of, the brain as an automatic mechanism, and which regulates its automatic activity. To facilitate the comprehension of this view, Dr. Carpenter personifies the energy which he names "a self-determining power" and "the will," and says, that in working out volitional acts this energy does not distinctly produce the result of any volition, "but plays, as it were, on the automatic apparatus by which the requisite nervo-muscular combination is brought into action." He adduces two proofs of this view—one a scholastic hypothesis, promulgated by Cardinal Manning, which excludes all consideration of the mechanism of thought and will; the other his own, founded on such consideration. It naturally follows that if by any chance "the will" be withdrawn or be prevented exercising its control (and this is the condition of the insane and the dreamer) the automatic action of the brain comes into play, and the individual becomes an *automaton*—conscious, it is true, but with no power to regulate his thoughts and conduct. The lower animals have not this will-power; hence, are natural yet conscious automata. Their intellectual condition is like that of dreaming or of childhood in man. But Dr. Carpenter shall state his own views:—

"We can scarcely desire a better proof that our possession of this power is a reality, and not a self-delusion, than is afforded by the comparison of the *normal* condition of the mind with these various *abnormal* conditions hereafter to be described (chaps. xiv-xvi.), in which the directing power of the Will is in abeyance. For the "subjects" of these

conditions may *really* be considered as mere thinking automata, puppets pulled by directing strings; their whole course of thought and of action being determined by suggestions conveyed from without, and their own will having no power to modify or direct this, owing to the temporary suspension of its influence."—(Mental Physiology, p. 6.)

Here a metaphor is put for a fact of observation; for obviously it cannot be truly affirmed that there is any biological resemblance between a puppet or doll having its limbs moved by pulling the strings attached to them, and the man who made the puppet and pulls its strings. Nor can it be rightly affirmed that when a man is influenced by what are metaphysically termed *motives*, and which are also motives in a physical sense, when considered as due to brain-work, that he is a mere mechanical automaton, or puppet the strings of which are motives. In the philosophical use of the terms *automaton*, *automatic*, *puppet*, as in that of the word *cerebration*, Dr. Carpenter has, in truth, followed thinkers of the hylo-zoic school. Mr. H. G. Atkinson, the co-worker with Miss Martineau in their "Letters on the Laws of Man's Nature and Development," was a co-worker with Dr. Engledue; and this is what Dr. Carpenter quotes from their book. "I feel" (say these authors, affirming the fact simply for themselves, be it observed) "that I am as completely the result of my nature, and impelled to do what I do, as the needle to point to the north, or the puppet to move according as the string is pulled. I cannot alter my will, or be other than what I am; and cannot deserve either reward or punishment."

Now, it is as to these views that I wholly differ from Dr. Carpenter. It seems to me that to have a self-determining power, now operating, now idle,—as men are dreaming or waking, drunk or sober, insane or sane, young or middle-aged,—and all this without a reasonable hypothesis as to whence the power comes and how it ceases, is not only no advance in our knowledge, but is opposed to the first law of both mental and corporeal life, the evolutionary unity of mind and organization. According to my views, every living organism is an *automaton* in the primary meaning of the word, just because it is living, inasmuch as it is constructed not only so that it shall be able to adapt itself to an external world, but also that the multifarious internal mechanism, whether of the brains or elsewhere, shall be in constant adaptation to each other. What, then, Dr. Carpenter attributes to an energy distinct from the mechanism, I attribute to a mechanism con-

stituted by an energy, and having the express function of inhibiting, or otherwise regulating, acts that are favourable or contrary to the general ends attained by the adaptations of the organism; which are the conservation and well-being of the organism and the continuance of the species of organised beings. Of course, this argument will be objected to by the hylo-zoic school of philosophy as "teleological;" but if it be admitted that life is itself a series of adaptations (as is affirmed by all) it follows logically that there is at least an end *attained* by the working of the mechanism, although there may be no end *purposed* by it. If the lungs and their motor apparatus do not, by their adaptations as mechanism, attain the ends of aeration of the blood and other work, what is the mechanism for? It is thus, also, with the mechanism working in adaptations to ends which constitutes the human brain. Ends are *attained* by its working; but by the same mechanism we are enabled both to know that ends are attained, and also to purpose and desire to attain, and to energize or "conate" for the attainment of desired and purposed ends. This latter endowment—as to the lower desires, sentiments, and conations—animals possess; the *knowledge* of the ends to be attained, and how, and the capabilities which enable man to know and to attain moral and intellectual ends, and to feel correlative desires are, doubtless, more especially human as to their organic bases. But throughout the whole chain of the adaptive phenomena of life, the same energy by which the living mechanism is constructed, is the energy by which organisms energise to ends, and are conscious; and man is enabled to make his mechanism subservient to the attainment of his *purposed* ends. Ends to be purposed must, obviously, be both known and foreseen. Just, therefore, as the mechanism available for knowing and foreseeing is evolved and perfected—of which acquired knowledge, as memory, is the chief manifestation—so the man becomes more free because more knowing and foreseeing. Hence, knowledge is not only a power to do freely, but a means to acquire mental freedom. If this were not so, why do sects seek not only to fix in childhood the knowledge and habits which will govern the future man, but also endeavour to exclude that knowledge which would constitute a freely-acting brain? Clearly, then, to make free men, the child should be taught to use that mechanism by which man is constituted a free agent.

VII.—As to the ordinary metaphysics of the Will, I need hardly say that to discuss "fixed fate, free will, foreknow-

ledge absolute" is no business of the physician. In thus departing from the study of the inexorable realities of life, he would be sure to suffer the fate of Milton's fallen angels, and be "lost in wandering mazes." I may, however, properly say here that I went physiologically over the ground which Dr. Carpenter has taken up as to this influence of "the will" and of attention and suggestion on the hemispherical ganglia and on the body, more than thirty-seven years ago, and arrived then at the same conclusions which Dr. Carpenter reached later and has fully developed in his "Mental Physiology," evidently in ignorance of my published researches. At that date I came to the conclusion, from both observation and experiment, that three deductions might safely be made from mesmeric phenomena as to the relations of Attention and the Will, viz.:—1. That if in certain brain-states the attention be directed, by suggestion or otherwise, to any portion of the body, changes in the circulation and nutrition, or molecular constitution, of that portion result. 2. That the attention may be so directed either voluntarily or involuntarily; and, 3. That for the purposes of deception, or otherwise, various mesmeric and other cerebral phenomena can be induced by the subjects of the experiments volitionally, or as they pleased. These deductions necessarily led to inquiries into the physiology and physiological anatomy of the Will, Attention, &c., and more especially I asked, where is the seat of these processes in the brain? For there the influence must arise and thence be sent to induce at least the corporeal phenomena in question. Now, Gall and his followers had already fixed the cerebral seat of the moral and intellectual will, and of the perceptive and reflective faculties (the intellectual powers of the old metaphysic), and of the moral feelings and sentiments, in the grey matter of the convolutions—the *cerebrum* of Dr. Carpenter. There, also, physiologists who held the hypothesis of the will as a self-determining power, imagined that the will operated, sitting behind the mechanism of thought and act, as a performer sits behind a piece of mechanism. This I mentioned as the notion of Johannes Müller at that date.* At the same time I discussed the influence of the will on the hemispherical ganglia, but more especially as

* "Professor Müller conceives the [motor] nerves to be all spread out at their central extremity to receive the influence of the will, and compares them, as they lie side by side, to the keys of a piano on which our thoughts play or strike. (Physiology, p. 686 of Dr. Baly's translation.) This seems to be a favourite idea, as it is repeated by the Professor."—(My essay in *Edin. Med. and Surg. Jour.*, July, 1839, p. 13.)

attention, which latter I distinctly discriminated as being either voluntary or involuntary.* The views I then held are nearly identical with those which Dr. Carpenter now propounds, in his "Mental Physiology," *passim*; but I have long abandoned them as erroneous. It seems to me that a more correct generalisation can be attained, if we take in the well-established fact that the grey matter of the convolutions is made up of strata or layers of cells, and the probability that each layer has its distinct functions in connection with corresponding layers of the corpus callosum lately discovered. An analysis of the processes named perception, attention, and ideation, both in healthy and disordered brain-states, shews that they are organically distinct, so that each needs to have its corresponding mechanism. And since the acquisition of knowledge and the evolution of "mind" means, organically, evolution of the hemispheres, it is probable that in the higher layers that process takes place by which knowledge is acquired, which I have named synesis, and the *substrata* are produced on which knowledge depends organically, as explained in my "Chapter on some organic Laws of personal and ancestral Memory"† to which Dr. Ireland refers. The reproduction of these, directly or indirectly, as ideas constitute reminiscence; and if with that reproduction there be also an act of energy to attain a desired end, that "conation" reaching the consciousness is an act of will organically. Consequently, strength of will depends, other things being equal, on the vigour of nutrition of those convolutions. It seems to me, therefore, that the localisations of Gall, to which Dr. Carpenter still strongly objects, as well as those of Hitzig, Ferrier, and others (all which tend to confirm Gall's views), constitute the most available anatomy of the Reason and the Will, considered as the intellectual powers.

The trophic influence of the convolutions on the muscular system in developing heat and nutrition of muscles, as well as motor energy in acts of willing, is only a part of the work which ideational *substrata* situate therein do. All those changes in the circulation, secretion, and activities of viscera that coincide with emotions, suggestions, directed attention, and the will, belong to the same class as the volitional, but with this

* Essay just quoted in Edin. Journal, p. 16, sect. 46, *et seq.*, and my Treatise on the Nervous Diseases of Women (1840), in chapter x, p. 109, headed "The action of the Will and of Internal and External Stimuli on the Hemispherical Ganglia."

† Journal of Mental Science, July, 1875, p. 158, 159.

difference—that, inasmuch as the work done is internal to the organism, there is no perception and no knowledge of the order of events, such as is attained when a man energises to attain an end he desires by the use of his limbs, and can see or perceive that it is attained. Knowing he has a heart, he may, however, by frequent effort, influence its motions volitionally, and may even contract and relax his iris at will. The great trophic centre by and through which the hemispheres thus act in emotions and volitions is probably, according to my researches, the cerebellum. If this be out of gear, as in emotional dreaming all the willing a man may make in his dream-fear and terror will not help him to move a limb or to utter more than a feeble wail.

(To be continued.)

Observations on the Brain of the Chacma Baboon. By HERBERT C. MAJOR, M.D., Edin., West Riding Asylum, Wakefield.

An opportunity having been afforded me, through the kindness of Mr. A. H. Garrod, of examining the brain of a fine specimen of the Chacma Baboon (*cynocephalus porcarius*) from the Zoological Society's Gardens, London, I purpose, in the following pages, to record, so far as I may be able, the minute structure of the convolutions in the various parts of the cerebral hemispheres. It will be my endeavour in this inquiry to study the nerve elements of the cortex step by step, and layer by layer, and thus gradually to unfold its structure; to analyse and compare the varying appearances in different situations; and finally, collecting and arranging the facts thus elicited, to place them side by side with those derived from a study of corresponding parts in the human organ, and ascertain, if possible, the relations which exist between them.

One of the largest and most powerful of the baboons, the Chacma, while considerably lower in rank, and having a brain less highly developed as regards its general characters than that of the Orang, Gorilla or Chimpanzee, claims fairly, nevertheless, a place among the higher apes. In it, as compared with the Chimpanzee, the convolutions of the hemispheres are generally less numerous and complex and there is less development of the frontal lobes; and, on the other hand, there is a corresponding increase in the size of the occipitals. The bridg-