the chest, of the abdomen, and of the pelvis, under the dominion of our science; that, by the institution of preventive medicine, he has swept away many of the opprobria, and of the direst scourges of former times; and it only remains to indicate in very few words the still vast field of further utility that lies open for cultivation by the practitioners of the future. There is one plague spot, I fear, which even he will fail to conquer; which will remain to fester, to kill its thousands, to maim, disfigure, and to sap the health of millions, of deserving and of undeserving alike, and, as the great curse of humanity, to baffle all our efforts to arrest the progress of disease, and to render them futile and abortive. You know the curse to which I allude; the curse that steadily and vindictively pursues the track of licentiousness, of ungoverned passion, of hateful sensuality; and you will admit with me that so long as human nature remains what it is, and is left in unbridled possession of the means of gratification, no ray of either light or hope will fall on that dark track.

Some day men may have become sufficiently enlightened to submit to necessary legislation and restrictions on this and cognate subjects; but, until they do, the foul stream of syphilis will continue to meander hither and thither, and whithersoever it will through the world of life; will poison its springs, will wither even its fairest blooms, and destroy its richest fruits without selection and without mercy.

By the cultivation of bacteriology and cognate sciences, by a deeper and more profound acquaintance with natural phenomena and laws, I can foreshadow in my mind the time when the whole range of zymotic and exanthematous diseases will have been subdued and conquered; when the seeds of each will have been isolated, and so studied that their individuality will be recognisable; the soils in which they will grow and those in which they will lie sterile will be known and appreciated, and be brought under cultivation by the hands of the medical men of the day; when the methods of dealing with them will be such that they may be reduced to harmless quantities; and when, by the spread of sanitary science, the whole human race may be protected from their evil influences.

It will not be in our day that these mighty triumphs will be won, but our successors will undoubtedly achieve them; and the time will certainly come when the kingdom of disease will be so closely narrowed down that only the necessary accompaniments of the changes and vicissitudes of natural laws, the evils attendant upon the wilful disobedience of those laws, the innumerable accidents to which life and limb must be for ever liable, and the inherent defects and deficiencies in the harmonious working of the parts of a machine so exquisitely and delicately constructed as is the frail body which, for a time, we inhabit will be the only kingdom in which the professors of medicine and surgery will be called upon to exercise their sway. Then will the victory of our science be complete, and the day will have come when the world will be called upon to acknowledge that the labours of the physician and the surgeon, patient, enduring, untiring, as they have been through all time, have not been in vain, and have reached their final consummation.

CHELLENHAM (Population, 46,950).—*Prevalence of Typhoid: traced to Use of Water from Shallow Wells.*—Notwithstanding the prevalence of typhoid fever during 1888, Surgeon-General Roch is able to report that the death-rate, 16.8 per 1,000, was lower than any recorded during the past fifteen years with one exception, that of 1881, when it was 15.8 per 1,000. He considers this due to a remarkable immunity from measles, the severe epidemic of 1887 having exhausted all the susceptible material. Of scarlet fever, only 3 genuine cases came under notice, and small-pox was entirely absent. One fatal case of diphtheria occurred, for which Mr. Roch could ascertain no other origin than the sleeping in a damp room on the ground floor, the paper on the walls being much mildewed. The total number of cases of typhoid fever were 107, of which the majority were traced to polluted water drawn from shallow wells in the low-lying parts of the town. Thirty-one deaths resulted, while diarrhoea caused 15, chiefly among infants. The zymotic death-rate for the year was 1.28 per 1,000. Mr. Roch again strongly condemns the use of water derived from shallow wells in the district. They are liable to gross pollution, and when it is remembered that there is an excellent public service available, the continued use of such wells is inexcusable. So long as they are continued in use the town will, in Mr. Roch's opinion, be subject, under certain conditions of rainfall, to a reappearance of fever.

ADDRESS IN MEDICINE,

BY

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ON THE COMPARATIVE STUDY OF DISEASES OF THE NERVOUS SYSTEM.

FIRST of all, I beg the President and Council of this great Medical Association to accept my heartiest thanks for the very high honour they have conferred on me in asking me to give this address. I have had much difficulty in choosing a subject, the difficulty being mainly in finding one on which I thought I had something to say, and on which I had not already said the little I was capable of. Finally, I concluded to consider once more, with all the care I could and with as little recapitulation as possible, the most important of general doctrines bearing on the science of medicine.

We have multitudes of facts, but we require, as they accumulate, organisations of them into higher knowledge; we require generalisations and working hypotheses. We have, so to speak, ready made for us, the hypothesis of evolution, one verified in numerous different cases. Huxley¹ writes: "The peculiar merit of our epoch is that it has shown how these hypotheses [one of which is the doctrine of evolution] connect a vast number of seemingly independent partial generalisations; that it has given them that precision of expression which is necessary for their exact verification; and that it has practically proved their value as guides to the discovery of new truth." I do not advocate the application of the doctrine of evolution to the classification of diseases for practical purposes, but believe, nevertheless, that its indirect value to clinical medicine is very great indeed, and that before long it will be directly helpful. Thinking that for clinical purposes we must continue to have arrangements of cases "by type,"² I once more urge that we should also attempt a parallel study of diseases as they are dissolutions—that is, reversals of evolution. By the latter means I hope that we shall be able to make broad and yet precise generalisations of great value. The man who puts two old facts in new and more realistic order deserves praise as certainly as does the man who discovers a new one. There is an originality of method. Gaskell has found out much that is new in his recent well-known researches on the nervous system; but I imagine that the greatest merit of his work is that he has made fruitful generalisations, and has set many things long ill assorted in realistic order. By doing this he will have put a stop to certain loose explanations in which the sympathetic figures. I do not pretend to be able to define generalisation as that term is used in science. May I say that it is the classification of things which are for the most part very different by some fundamental peculiarity each of them has? It is easy to see how one may be misunderstood when making generalisations after this fashion; one may be supposed to overlook important differences—not to be putting things in order but to be trying to organise confusion. I will give a series of illustrations of the method spoken of, because it is one I follow largely in this address.

1. A patient of mine had lost one hand, but, as is most often the case, he had, representing it, a phantom hand; this was always in a position as if encircling a vessel; the member had been blown off when he was holding a cylinder to be charged with an explosive. 2. An aphasic patient of mine frequently uttered, on being questioned,

¹ *Reign of Queen Victoria*, vol. ii. p. 340.

² *JOURNAL*, July 14th, 1888.

³ In his magnificent work, *Diseases and Injuries of Nerves*, 1872, p. 355, Weir Mitchell writes as follows: "E. C., aged 32, lost his left arm, five inches below the shoulder, nine years ago. When shot, the thumb turned into the palm, and continued in this state of spasm, so that when, six hours later, the limb was removed, the nail of the thumb had cut into the palm. He several times lifted the thumb, but it always returned to the same spot. For nine years the absent thumb still remains cutting into the palm." After speaking of various positions of phantom parts of limbs, Weir Mitchell writes (*op. cit.*, p. 354): "Another class has the hand constantly in some painful position which it occupied before the operation, so that the last real sensation is so stamped upon the sensorium as to forbid its erasure by any future impression."

but with no relevance to anything going on, "Come on," or "Come on to me;" he was a signalman, and had been taken aphasic and hemiplegic on the railway in front of his box; the presumption is that he was saying, or was about to say, those words when taken ill. 3. An epileptic patient told me that his first fit occurred when he was a soldier, and at the very time he was "numbering off;" after every subsequent fit, and before regaining consciousness, he used to count; this we observed when he was in hospital. 4. A woman I was asked to see in a surgical ward in the London Hospital, who had fractured her skull by a fall when laying down oilcloth on a staircase, kept, during partial unconsciousness a few hours before death, manipulating the counterpane of her bed. We supposed this to be a sort of continuance of the action of laying down the oilcloth; the patient desisted, for a time at least, when the nurse assured her that "it was properly laid."

These illustrations will appear incoherently grouped to those who do not happen to see that the intention in stating them is not to deal with stumps, aphasia, epilepsy, and injury to the head, but to make a basis for the discovery of the reason why there is a fixation of states, which are normally temporary, upon the sudden occurrence of lesions of the nervous system;⁴ very different cases are chosen in order to make the basis a broad one. This is by way of illustration, but I hope that such facts are of some value towards the methodical study of persisting delusions. I suggest, quite hypothetically, that some very grotesque delusions may be a fixation of absurd beliefs in dreams, in cases where a sudden morbid change, or sudden increase of it, has occurred in the brain during sleep—such delusions as one mentioned to me by Dr. Savage; a patient of his believed himself to be a jar of Indian pickles.

Before going further, I must mention that most valuable work has been done by Anstie, Ross, Ribot, Mortimer Granville, Mercier, and Bland Sutton in the application of the principles of evolution to normal and abnormal conditions of man's body. We ought not to forget that nearly half a century ago Laycock extended the doctrine of reflex action to the brain, and that so long ago as 1829 Von Baer announced "his great discovery, that the progressive change from homogeneity to heterogeneity is the change in which organic evolution essentially consists."⁵ I need scarcely mention the name of Herbert Spencer, except to express my vast indebtedness to him; the first edition of his *Principles of Psychology* appeared so long ago, as 1855, five years before the publication of the *Origin of Species*.

In the doctrine of evolution we have principles which no doubt apply to the whole organism and to every one of its diseases; it is at once a means of scientific classification and a guide to the discovery of new facts. Limiting myself in this address to the nervous system, I submit that ultimately those principles will help us to a more realistic explanation of symptomatology so different as those in a case of paralysis of an external rectus and those in cases of insanity. The comparative study of nervous diseases—the study of them as dissolutions—is a process of generalisation. To attempt this generalisation without prior careful analysis of the things concerned, needing minute clinical study of individual cases, is not likely to lead to anything of permanent value. To compare and contrast the mere local lesions and the symptoms directly dependent on them only in the two cases instanced is not good method. The symptomatology of each must be regarded as the result of a flaw in an evolutionary whole. It is one merit of the method I am urging that it deals not only with the local lesion—with that, I mean, which disease (in the strict sense of pathological change) causes—which alone is dissolution, but also with the healthy rest; that is, it takes into account the evolution going on in the undamaged remainder of the nervous system. The full symptomatology of a case of ocular paralysis is not to be intelligently stated even unless activities of healthy centres, including the highest (all centres above the peripheral lesion) are considered; and a case of insanity is not properly analysed unless undiseased parts of the highest centres and all lower centres are considered (*vide infra*). In the two cases a great part of the symptomatology is owing to over-activity of perfectly healthy nervous arrangements; the erroneous projection and diplopia in the first, and the illusions, delusions, and all other positive mental symptoms in the second. To insist on the principle im-

plied, I say in recapitulation that every case of nervous disease is a problem, not only in dissolution but in evolution; in example, he who is studying the physical process during an illusion in an insane patient is as certainly dealing with evolution as he is who is studying that process during the perception of a healthy person.

Before I give particular illustrations of dissolution, I will make brief statements concerning some different aspects of the one process evolution, of which dissolution is the reversal: (1) evolution is a passage from the most to the least organised. I must stay to remark on the term organised. "Highly organised" is frequently used synonymously with "very complex;" but by degrees of organisation I mean degrees of perfection of union and certainty of action of nervous elements with one another. Using the term organised in this sense, I say that the highest cerebral centres are the least organised (the "most helpless centres"), although they are the most complex, whereas the lowest centres are the most organised, although the least complex. In other words, we may say (2) that the evolutionary ascent is from the least to the most modifiable. If the highest centres were not modifiable, we should be very simple machines; we should make no new acquisitions. If the lowest ("vital") centres were to become as modifiable as the highest are, life would cease. It is only another aspect of this statement—that the progress in evolution is from the most to the least organised—to say (3) that the passage is from the most automatic to the most voluntary (properly, "to the least automatic"); equivalently it is (4) from structures inherited most nearly perfected (acquirements of the race and of præhuman beings), such as the cardiac centres in the medulla oblongata (some centres of the lowest level of evolution)—from those comparatively perfectly evolved at birth—to those of the highest nervous arrangements of the highest centres, which are only incipient nervous structures, and which are evolving during the latest new mental states; (5) the process of evolution is from the simple to the complex; (6) from the general to the special. Reversals of evolution are effected by pathological processes, and are called dissolutions; they are reductions from the least organised, etc., towards the most organised, etc.

I can give no good illustrations of dissolution from lesions at the periphery. Nor can much that is definite be said in this regard of lesions of the spinal system (lowest level of evolution of the central nervous system). Yet we may say that in most cases of the ordinary form of progressive muscular atrophy the muscles first morbidly affected are the small muscles of the hand, and that in most cases of Duchenne's bulbar paralysis the tongue is first invaded. In these two cases the most special parts, in manipulation and in articulation respectively, fail first. Going higher up in the nervous system we find definite and certain illustrations. It is plain that hemiplegia from disease in the mid-cerebral region is a failure in the order from "most voluntary" towards most automatic; whether chorea and paralysis agitans are due to morbid changes in the region mentioned or not they certainly illustrate dissolution in the very same way as hemiplegia does. The numerous different phenomena of cases of aphasia are the best illustrations of the process of dissolution, but I have stated them several times.⁶

Dr. Donald MacAlister has pointed out in his admirable Croonian Lectures that the febrile process exemplifies dissolution. "The thermal nervous system," to use his words, "has three parts; let us call them briefly the thermotaxic or adjusting, the thermogenic or producing, and the thermolytic or discharging mechanism."..... "In the ascending scale of evolution," he continues, "we seem to rise from the thermolytic to the thermogenic, and thence to the thermotaxic nervous system." He considers fever as a process of dissolution, and, next, recovery from fever as a process of re-evolution. Some, presumably all, cases of insanity illustrate dissolution. I will content myself with quoting very briefly from that part of Dr. Savage's important work, *Insanity*, where he deals with general paralysis. In these cases, he writes, that the disease "affects first the highest intellectual and motor acquirements is undoubted." He says, too, "Both Dr. Maudsley and I have independently taught that in this progressive degeneration the last and highest acquirements fail first."..... We have very good illustrations of dissolution in the symptomatology of drunkenness. Long ago Charles Bell wrote:⁷ "It is a fact familiar to pathologists that, where debility arises from affection of the brain, the influ-

⁴ In the case of No. 1 the hand was blown off at a time when particular nervous arrangements of the nervous centres, from highest to lowest, were being discharged. The persisting memory, so to call it, of the last position of the lost hand implies a persisting state in the highest centres. Why that state remained permanently, it is for me impossible to say.

⁵ Fiske, *Cosmic Philosophy*, vol. i, p. 342.

⁶ JOURNAL, March 29th, 1884.

On the Nature of Fever, *Lancet*, March 26th, 1887.

⁷ *Nervous System*, 3rd ed., p. 165.

ence is greatest on those muscles which are, in their natural condition, most under the command of the will. We may perceive this in the progressive stages of debility of the drunkard, when successively the muscles of the tongue, the eyes, the face, the limbs, become unmanageable; and under the same circumstances, the muscles which have a double office, as those of the chest, lose their voluntary motions and retain their involuntary motions; the force of the arms is gone long before the action of breathing is affected.⁹ Lauder Brunton, in his *Pharmacology*, 3rd edition, p. 146, writes: "In the action of such poisons as alcohol, the nervous system appears to be paralysed in inverse order of its development; the highest centres going first, next the middle, and then the lowest. After this comes paralysis of the motor nerves, and, lastly, of the muscles themselves."

I now give a curious illustration. We see, not dissolution, but, this time, evolution illustrated by certain surgical cases—by the order of persistence of spectral representatives of parts of limbs lost by amputation. Weir Mitchell writes:¹⁰ "The limb is rarely felt as a whole; nearly always the foot or the hand is the part more distinctly recognised, and, on careful questioning, we learn that the fingers and toes are readily perceived; next to these the thumb; then more rarely the ankle or wrist; and, still less frequently, the elbow and knee. Very often some fingers are best felt, especially the forefinger." This, the order in which the lost parts remain most vividly represented in consciousness, is almost exactly the order in which the parts physical do fail in dissolution of the nervous system.

Speaking most generally, and ignoring some very obvious qualifications, we may say that the hemiplegic man is reduced to a more automatic condition of movement, the aphasic to a more automatic condition of language, and the insane man to a more automatic condition of mind. There is a reduction to a lower level of evolution in each series.¹¹ Dissolution is exemplified in each of the following exceedingly different symptoms: 1. Most epileptiform seizures begin in the thumb or index finger, or in both; these digits are the most special parts of the body. 2. The words most often left to an aphasic who is, for the rest, entirely speechless, are "yes," or "no," or both; these "words," as I called them, are the most general of all propositions. 3. The aphasic may be unable to put out his tongue when told, although he moves it well in other ways; loss of the "most voluntary" movement, with persistence of the more automatic movements of that organ. 4. In what is called word-blindness, there is inability to recognise the latest learned, and very arbitrary, "objects," letters, and words, whilst the recognition of objects, properly so-called, is unimpaired, or comparatively so. 5. In early stages of atrophy of the brain, say, in that occurring so often after hemiplegia in men past middle age, there is defect of memory for recent events with seemingly good remembrance for long past circumstances, and there is at the same time loss or defect of the "finest," latest acquired emotions, with obtrusion of the coarser and earlier acquired. Different as these five examples are, they are alike in that dissolution is definitely illustrated by each of them.

I here stay to remark on what I think is the evolutionist's measure of mind. Opinions will differ vastly as to who are the men of greatest mental elevation. Some would put Napoleons highest, others Shakespeares and Goethes. But evolution, I think, supplies us with a scientific measure, which ignores superior and inferior, as these terms are ordinarily used with regard to men's minds. This measure is according to the intellectual and emotional differences between lower and higher races of mankind, and to those between children and adults. Higher races of men and adults have the latest acquired faculties, and these, according to Spencer, are, intellectually, the power of abstract reasoning, and, emotionally, the sentiment of justice. So that, instead of saying that a person is superior or inferior to most other men, we may say that he has more or less of the latest faculties of the race than most other men have. I by no means think that to have the latest intellectual faculties most highly developed is the same thing as being most endowed intellectually. I submit that the poet inherits in some ways more of the earlier acquired faculties of the race, and has less of the latest than the scientific man has; yet no one would say that poets are mentally inferior to scientific

men. In the cases of atrophy of the brain recently instanced, there first occurs defect of the two "latest" faculties I mentioned; the patient easily becomes confused by consideration of things of a little complexity, and of which the elements are not before him, and is often peevish and selfish.

I admit that I have selected cases which will suit my purpose best. Some cases seemingly exceptional are not so. It is not meant that in every case of nervous disease the most voluntary of all parts of the body suffer first and most. Were that so all nervous diseases would affect first and most the thumb and index-finger. The word voluntary, a psychological term, is not the right word to use when speaking of physical processes. The progress of dissolution, properly stated on this aspect, is from the least automatic towards the most automatic. And in disease of any centre it is only supposed that the "most voluntary" (least automatic) parts represented by that centre suffer first and most. In an epileptiform seizure, beginning in the leg, the great toe is nearly always the part first in spasm; the "most voluntary" part of the leg suffers first and most from the cortical discharge.

To take a more extreme illustration. It may be said that the symptoms from morbid changes in the cerebellum do not accord with statements made as to the process of dissolution. I believe that all the skeletal muscles are represented in the cerebrum in one set of movements, and that all of them are represented in the cerebellum in another set of movements. In rough and only partial statement the order of representation in the cerebrum is of movements of the arm, leg, and spine. This agrees with a popular doctrine, for the order is that of the degree in which the three parts of the body are "under command of the will." The order of representation in the cerebellum is of movements of the spine, leg, and arm. This accords with the current doctrine that the cerebellum co-ordinates (*vide infra*) movements of locomotion. (I presume that a man's spine must be braced up before his legs can come into play in walking.) So that, ignoring the term voluntary on account of its psychological implications, and using the term special, we say that the arm is the most special part in the cerebral series, and fails first in disease of the brain proper; and that the back is the most special part in the cerebellar series, and fails first in disease of the cerebellum.

I now try to consider evolution and dissolution more methodically. I submit the following statements:—By aid of the doctrine of evolution we shall discover a harmony or rational parallelism between (1) psychology, (2) the anatomy and physiology of the nervous system, and (3) that important part of clinical medicine which deals with diseases of this system. It will help us towards a comparative study of all diseases of the nervous system, and in particular, to the realistic comparison and contrast of cases of insanity—diseases of the highest cerebral centres—with diseases of lower centres.

The doctrine of evolution implies that the whole nervous system has a sensori-motor constitution. It has long seemed to me that only on this basis can we show how it is that such very different sets of symptoms as convulsion and insanity (and, as I think, paralysis) are owing to disease of the cerebrum proper. The assignment of such a constitution to the whole of the nervous system shows that, when I speak of diseases of that system, reference, explicit or implicit, is always to parts of the body. (By "parts of the body," I mean non-nervous parts.) It is a merit of the method that parts of the body are necessarily taken into account in all nervous lesions. The nervous system by itself is a functional nothing; it is only something as representing parts of the body.

I carry the doctrine of sensori-motor constitution of the nervous system further than anyone else, so far as I know, since I urge that the highest cerebral centres (the "organ of mind" or anatomical substrata of consciousness) represent parts of the body as certainly as that of the lumbar enlargement does; they are evolved out of lower centres, which, as everybody admits, do represent parts of the body. No one denies that the highest centres contain sensory elements; no one denies that very many, if not all, parts of the body are represented sensorily in the "organ of mind." But to their representation motorily in that organ there seems to be great objection. It is not many years since the ascription of motor representation to any part of the cerebrum proper was denied. It is agreed upon now that some convolutions (Rolandic region) contain motor elements—and, according to some, nothing else. The præ-frontal lobes (convolutions in front of the Rolandic region) are said to be, or to be part of, the "mental

⁹ My friend and colleague, Dr. Gowers, drew my attention to this passage: I gave the quotation, *Lancet*, February 15th, 1873. (On the Anatomical and Physiological Localisation of Movements in the Brain.)

¹⁰ *Op. cit.*, p. 350.

¹¹ Dr. Mortimer Granville, who has for some years applied the doctrine of Dissolution, uses the term "denudation," and takes note of the "exposure" of the lower layers, which I call the lower levels of evolution, remaining.

centres." I admit that they are a great division of these "mental centres," but say that they are motor too—that they are the highest motor centres. And Ferrier, who agrees with me in thinking that these lobes are motor, finds that, after their ablation in monkeys, there is degeneration of fibres "descending" as low as the medulla oblongata, but no lower; this is proof positive that the præ-frontal lobes are, at least to some extent, motor. I will here state in outline what I believe to be the hierarchy of the motor centres, only alluding to that of the sensory series and ignoring the cerebellum.

1. The anterior spinal horns and their homologues higher up (nuclei of motor cranial nerves) are the lowest motor centres (both of the cerebral and cerebellar systems). These lowest motor centres, with the corresponding sensory centres, make up the lowest level of evolution of the central nervous system.

2. The convolutions of the Rolandic region are the middle motor centres of the cerebral system. With the corresponding sensory centres, they make up the second or middle level of the central nervous system.

3. The præ-frontal lobes are the highest motor centres of the cerebral system. With the corresponding sensory centres, they make up the third or highest level of the central nervous system, that is, the "the organ of mind."

Here I may best remark on the differences between muscles and movements, a matter of vast importance. To speak figuratively, the central nervous system knows nothing of muscles, it only knows movements. I have already stated the speculation that all muscles of the skeleton are represented in the cerebrum in one set of movements, and all in the cerebellum in another set. I here give another illustration simplifying it in several ways. There are, we shall say, thirty muscles of the hand; these are represented in the nervous centres in thousands of different combinations—that is, as very many movements; it is just as many chords, musical expressions, and tunes can be made out of a few notes. I now speak of the representation of the muscles of the hand in the three orders of motor centres just spoken of. 1. In some lowest motor centres (anterior horns) which are evolved out of the muscles of the hand, these muscles are represented in numerous different combinations, as simple and very general movements. 2. In the middle motor centres (Rolandic region) which are evolved out of the lowest motor centres, the same muscles are represented (re-represented) in still more numerous different combinations, as complex and special movements. 3. In the highest motor centres (præ-frontal lobes), which are evolved out of the middle motor centres, the same muscles are represented (re-re-represented) in innumerable different combinations, as most complex and most special movements. Anticipating in part what is to come, the last representation is of "finest" movements of the hands in the anatomical substrata of tactual ideas and of other mental states.

I fear the doctrine of sensori-motor constitution of the "mental centres" will be a hard one to many of my medical brethren. My contention, nevertheless, is that the highest centres ("organ of mind") have no other function than that of representing or co-ordinating parts of the body; bearing in mind the subordinate centres, we may say that they represent parts of the body triply indirectly. Function is a physiological term, and it is, I submit, improper to speak of states of consciousness as being "functions of the brain;" we can only say that states of consciousness attend functioning of the brain, of those parts of it, at least, which are the highest cerebral centres. We can only affirm concomitance, and why immaterial processes always go along with the material processes of our brains is, as yet at any rate, inexplicable. The late Professor Clifford wrote:¹² "I may very well say that among the physical facts which go along at the same time with mental facts, there are forces at work. That is perfectly true, but the two things are on utterly different platforms, the physical facts go along by themselves, and the mental facts go along by themselves. There is a parallelism between them, but no interference of one with the other."

It is neither more nor less easy to understand the nature of the relation of the two utterly different and yet concomitant things if the physical thing, the "organ of mind," has a sensori-motor constitution, than it is on any other hypothesis as to the constitution of that organ. Here is an express repudiation of any intention on my part to attempt to explain psychical states by anatomico-physiological states. It is not the mind, but the physical basis of mind, which is a product of evolution; it is the organ of

mind, not the mind, which, being an evolution out of the rest of the body, is representative of it. When tracing an evolutionary ascent from the muscles of the hand to the highest cerebral centres nothing was said even remotely implying that the most complex, etc., representation of these muscles became, or became part of, tactual ideas; it was only said that this most complex, etc., representation was part of the physical basis of those ideas. I know of no evolutionist of repute who has attempted the marvellous feat of "getting the mind out of the body." For my part, I am content with "getting" the organ of mind out of the rest of the body.

I contend that the highest centres represent all parts of the body, literally all parts supplied by nerves—not only sensory regions and muscles of such parts as eyes and hands ("organs of special sense"), but of legs and arms, of internal viscera, of external viscera (as sweat glands), and all the rest. Under the head of movements, one takes in effects produced in glands by what the physiologist calls their motor nerves, and also negative movements, so to call them, that is, effects on musculatures produced through the intermediation of inhibitory nerves. The highest centres are centres of universal representation or co-ordination. When dealing with the physical condition in coma, Dr. Mercier writes: "Thus we arrive at this most important conclusion: that the highest nervous processes, which form the substrata of the most elaborate mental operations, represent at the same time not only the most elaborate forms of conduct and muscular movements, but also every part of the organism (italics in original) in some degree."¹³ Ribot, in his remarkable and most valuable work on *Personality*, writes: "Nous pourrions dire que la couche corticale représente toutes les formes de l'activité nerveuse; viscérale, musculaire, tactile, visuelle, significatrice."

No one doubts that the lowest level of evolution (roughly, pons, medulla, and cord) represents all parts of the body; it is certain that motor effects in nearly all parts of the body are produced by discharges of the so-called "motor region" (motor division of the middle level). I am only going a step further when I suggest that the highest level (although "for mind" in the sense of being the physical basis of mind) is also universally representing. A higher level of evolution is, so to put it, the lower "raised to a higher power." Each of the levels being universally representing their evolutionary differences are in the degree of complexity, etc., in which each represents all parts of the body.

The phenomena of an ordinary epileptic fit, epilepsy proper (I am not speaking of epileptiform seizures, which are owing to sudden discharges beginning in parts of the mid-cortical convolutions, or, as I call them, middle motor centres) seem to me to accord with the hypothesis of sensori-motor constitution of the highest centres and of their universality of representation.¹⁴ Cessation of consciousness being the first, or a very early, physical event in the paroxysm, I presume that the first correlative physical event must be a discharge (here a sudden and excessive one), beginning in some part of the physical basis of consciousness (highest centres). Now, it is certain that in a severe epileptic fit there are effects produced in nearly all, presumably in all, parts of the body, and obviously the effects we see are motor or their equivalents. In a slight fit of epilepsy (*le petit mal*), the effects are widely distributed; they are so various as pallor of face, increase of saliva, arrest of respiration, and emission of urine. The effects are crude, but this does not invalidate them as witnesses to the representation of parts of the body in the highest cerebral centres; the process by which they are produced is a crude one; the "epileptic discharge" differs from normal discharges in being sudden, excessive, and rapid; and also, I submit, in starting in some small part of the highest centres (a "discharging lesion" or "physiological fulminate").

That artificially induced discharges of parts of the Rolandic region (middle motor centres of the cerebral system) produce effects in nearly all parts of the body, visceral included, is demonstrable. No one doubts that in this region all the skeletal muscles are represented in movements; but the organic parts also, presumably all of them, are represented in it. If curara be given to a dog, its skeletal muscles are, by paralysis of their motor nerve-endings, put out of reach of the effects of central discharges; upon Faradic excitation of the curarised animal's sigmoid gyrus (artificial respiration being kept up) the fit is

¹³ *Brain*, January, 1887.

¹⁴ I have considered in detail the phenomena of epileptiform paroxysms with reference to the hypothesis of universal representations by the highest cerebral centres in the Bowman Lecture, *Trans. Oph. Soc.*, vol. vi.

¹² *Fortnightly Review*, December, 1874, p. 728.

limited to the organic parts; we witness effects on viscera or their apparatus which we can never observe in man; the dog's abdomen having been opened, there are seen, among other effects, increased flow of bile, a little paling of the kidneys, and contraction of the spleen. In this case the artificial discharge is started in part of the middle motor centres; but, at any rate, that universal effects are so produced gives some countenance to the supposition that the convulsions in front of these centres, highest motor centres, are also universally representing.

Another way of stating the function of the highest cerebral centres is to say that whilst a man is having states of consciousness (in artificial analysis, Willing, Remembering, Reasoning, and Feeling) there are occurring correlatively with those purely psychical states the physical things, slight discharges of nervous arrangements of his highest centres representing the whole of his body. In differing states of consciousness different nervous arrangements of these centres representing or co-ordinating different particular parts of his body more than all the rest will be engaged.

It is just here that the harmony of psychology with the anatomy and physiology of the nervous system is, I think, to be best seen; it is here too that the basis for the comparative study of cases of insanity (diseases of the highest centres) with diseases of lower centres is established. I have elsewhere¹⁵ analysed very briefly, and, I admit, very imperfectly, the highest cerebral centres considered as they form the physical basis of consciousness.¹⁶ The conclusion from that analysis was that the highest cerebral centres are sensori-motor arrangements representing all parts of the organism in most complex, etc., ways—a conclusion agreeing with the hypothesis of evolution, and strictly according with the phenomena of epileptic paroxysms. If that analysis be valid, there is no difficulty in seeing how it is that epilepsy proper is a disease of the "organ of mind." The epileptic convulsion is a brutal development of the most complex, etc., movements represented in the anatomical substrata of the four "faculties" mentioned, along with a development of the less complex, etc., movements represented by the middle and lowest motor centres.

I will here analyse the physical basis of but one mental state, artificialising largely. There is no such thing as a separate centre for tactual ideas, but for simplicity of exposition, we may imagine some part of the highest centres to be such a centre; popularly, it is a centre for objects explored by the hands. When we actually explore an object the skin of our fingers and the muscles of our hands are engaged; and at the same time all sensory centres from lowest to highest, and all motor centres from highest to lowest. The tactual centre represents the skin and muscles of the part of the periphery mentioned—is sensori-motor in that way. The sensory element in the tactual centre corresponds to the surface of objects (the homologue of colour in visual perceptions and ideas), the motor element to their extension (shape and size). I have already mentioned the motor element when speaking of the hierarchy of motor centres. I illustrated by the representation of the muscles of the hand; their final representation (re-representation) in the highest centres is the motor element in the tactual centre.

During the actual exploration of an object there is a vivid mental state; we may call it a tactual perception. Now suppose we think of the object when it is absent, popularly, "have an idea of it;" there is then a faint mental state, a tactual idea. In both cases the centre for tactual ideas is engaged; a tactual idea is a faint tactual perception, and a tactual perception is a vivid tactual idea; the centre for tactual ideation and for tactual perception is one; it is made up of the same sensori-motor arrangements of the highest centres.

But it may be said that whilst thinking of the object there is no movement, and it may be averred that the correlative physical process is sensory only; but the sensory element corresponds only to surface; the extension requires accounting for; the object thought of has shape and size. I submit that there is corresponding to extension slight discharge of the motor nervous arrangements of the tactual centre, which, when strongly discharged in

the actual exploration, did move the hand; there is "nascent movement." The physical difference more fully is that (1) during exploration of the object, having a tactual perception, the tactual centre is strongly discharged from the sensory periphery, and reacts upon the muscular periphery; there is strong and complete sensori-motor action, all orders of centres being engaged; whilst (2) during thinking of the object, having a tactual idea, the tactual centre is slightly discharged, and the discharge is limited to the centre; there is weak and incomplete sensori-motor action; the highest centres alone are engaged. In both cases there is sensori-motor action, in both the same nervous arrangements of the highest centres—those representing the skin of the fingers and the hand muscles—are discharged. So far for two degrees of normal discharges of the tactual centre. Now let us suppose that a sudden, excessive, and rapid discharge (such a discharge as that which produces an ordinary epileptic fit) begins in some part of the tactual centre, and soon involves the whole of it. We should then have a miniature epileptic fit. During the onset there would be tingling referred to the fingers; there would be (middle and lowest centres being subordinately engaged) also convulsion of the hand. No tactual ideas would arise during such a discharge.

Asking you to accept provisionally the conclusion that the anatomical substrata of will, memory, reason, and emotion (together states of consciousness), represent parts of the body (together, all parts of it, sensorily and motorily), in most complex, etc., ways, I go on to speak of the relevance of that hypothesis to the study of some important diseases. There is no difficulty in understanding that insanity arises from disease of the organ of mind. But we have to face this question. How is it that the superficially seeming quite different phenomena, 1, convulsion with cessation of consciousness (an epileptic fit); and, 2, insanity result from morbid affection of the "organ of mind" (highest centres)? This problem is forced on us. We cannot consider one of the two by itself, and ought not to try to explain each quite separately. For often enough there is the sequence, an epileptic convulsion with loss of consciousness, and then temporary insanity, for example, epileptic (post-epileptic, I think) mania. Moreover, I believe that paralysis also results from negative states of the highest centres; I submit that it exists in temporary post-epileptic insanities, indeed in every case of insanity.

After epileptic fits there is often insanity. There are two degrees of it; there is according to the severity of the paroxysm, mania, or coma, physically two depths of dissolution effected by the prior epileptic discharge. I first take coma,¹⁷ which is acute temporary dementia rapidly produced. Here I remark again on the need of distinguishing psychical states from nervous states. If anyone compares and contrasts post-epileptic coma as a negative psychical state with a case of paralysis, say hemiplegia, which is a negative physical state, he is attempting a pseudo-comparative study. I submit that the negative affection of consciousness in the comatose patient implies a correlative negative state of more or less of his highest centres which causes paralysis. It is not the negative affection of consciousness, but the paralysis from the negative state of elements of the highest centres which that negative affection of consciousness implies, which we can reasonably compare and contrast with the hemiplegia. It is true that in post-epileptic coma there is not limited, regional paralysis, such as hemiplegia or monoplegia; there is supposed to be some universal, I do not mean total, paralysis. I am not speaking of paralysis of the muscles. There is loss of some movements of all parts of the body. That there is some universal paralysis after a severe epileptic fit accords with the hypothesis of universal representation by the highest centres, and is in harmony with the universality of the convulsion in the prior paroxysm. If a man cannot move an arm after a convulsion limited to that limb, no one hesitates to call that condition a paralytic one. Why then should not the name be given to universal motionlessness after a universal convulsion? To say that the patient who is unconscious does not move because he is unconscious is to give an explanation which explains nothing. Beevor has noted lateral deviation of the eyes after epileptic fits; surely this is indirect evidence of some paralysis. Moreover, Westphal, Gowers, and Beevor have observed alterations of "deep reflexes" after such seizures, and this too accords with the view that the man comatose after such seizures is paralysed. Here let me say,

¹⁵ Croonian Lectures, JOURNAL, April 12th, 1884.

¹⁶ I then spoke of centres for Will, Memory, Reason, and Emotion, the artificially distinguished elements of consciousness. It was a mere artifice to imagine such centres. The evolutionist does not try to localise volition or any other mental faculty in the brain; he is content with attempting to localise parts of the body in the highest cerebral centres. For my part, I think there are not in the cortex-cerebri any abruptly demarcated centres for any kind of representation. The recent researches of Beevor and Horsley on the mid-cortex seem to me to show that the current hypothesis as to localisation is untenable.

¹⁷ I would refer all interested in the application of the doctrine of evolution to the investigation of diseases of the nervous system to Dr. Mercier's masterly article "Coma" (*Brain*, January, 1887), a most important contribution to the methodical study of insanity.

once for all, that no doubt in post-epileptic coma, besides paralysis from loss of most complex movements represented in the highest centres, there will be after a severe fit some paralysis from loss of less complex movements represented in the middle motor centres, and some from loss of simplest movements represented in the lowest motor centres. For in the prior severe epileptic fit all centres are engaged; there is an excessive process from highest centres to muscles. Indeed (Westphal, Gowers, and Beevor), after some epileptic fits there is temporary loss of the knee-jerks, showing exhaustion of the lumbar centres, which are some of the lowest centres.

The conclusion about post-epileptic coma is very important, for from it we make the hypothesis that there is paralysis in all cases of insanity, a widespread or universal paralysis—that is, paralysis of a kind corresponding to the universality of representation of the body by the highest centres, which are certainly diseased in cases of insanity. I must now briefly analyse these cases of disease of the highest centres.

In cases of insanity the mental condition is, as Dr. Monro long ago insisted, duplex; it is of two opposite elements, one negative and one positive; cases of perfect dementia, if there be such a thing, where the mental condition is entirely negative, are excepted. Ignoring perfect dementia, there is always some negative affection of consciousness (negative mental symptoms) in cases of insanity; there are degrees from slightest defect of it, such as that existing in trifling confusion of thought, to nearly complete loss of it, as in dementia, or in coma which is acute dementia. We must not speak as if there were no degrees between perfect consciousness and unconsciousness. There are also positive, often superpositive, mental symptoms coexisting with the negative. The defect of consciousness and the consciousness remaining (that is what I just called the positive mental symptoms) in cases of insanity vary inversely. When the positive mental symptoms are many and elaborate, and the defect of consciousness therefore little, the former may attract exclusive attention. Slight degrees of defect of consciousness are often disregarded. A patient may be said to be "perfectly conscious," and be said to have illusions, delusions, etc., as if these positive mental symptoms were his sole symptoms; but surely these positive symptoms of themselves imply the coexisting negative states of some non-recognition and some non-reasoning, that is, they really imply some coexisting defect of consciousness. A patient may be said to be "perfectly conscious," although, when his symptoms are given, he is described as apathetic, as forgetful, as confused, and as having lost regard for others; these popular statements are nearly, if not quite, equivalent to the technical statements that the patient is defective in will, memory, reason, and motion—in other words, that he is defectively conscious.

The correlative physical condition of the highest centres in cases of insanity is correspondingly duplex. The negative affection of consciousness implies a negative state of, or of elements of, some nervous arrangements (temporary loss of their function or actual loss of them) of the highest centres. It is this negative state alone which implies paralysis; this alone is dissolution, this alone is the result of disease in the sense of pathological change.

Now for the physical condition corresponding to the positive mental symptoms. As before said, when speaking of the case of paralysis of an external rectus and of cases of insanity, every nervous disease is to be considered as a flaw in an evolutionary whole; and the assertion was then made that great parts of symptomatology are owing to activities of healthy nervous arrangements. I submit that all the positive mental symptoms in the symptomatology of insanities occur during activities of healthy nervous arrangements remaining in the maimed highest centres; they are, or are parts of, the insane man's mentation; they are, or are signs of, his lowered consciousness; his illusions, as we call them, are his perceptions, and his mental symptoms altogether are lower homologues of his normal mentation, and are his will, memory, reason, and emotion. Putting the matter still otherwise, the positive mental symptoms do not signify dissolution; they signify evolution going on in what disease has spared; they are signs of survival of the fittest states on the lower, but now the highest, level of evolution remaining. The sensori-motor arrangements of this lowered level (sublevel of the highest level) may be over-active from loss of control, but this is a physiological abnormality; when I say that they are healthy, I mean that they are untouched by any pathological process; they are in the same case as the heart is when it is beating more frequently after section of the vagus. When a general paralytic believes himself to

be Emperor of Europe, I submit that this delusion does not arise during activities of any nervous elements touched by any sort of pathological process; but, on the contrary, that it is framed during activities in what remains of his highest centres, that is to say, in what disease has spared—presumably the posterior lobes and what is left intact of the anterior. This delusion (his belief) signifies evolution going on in the remains of a mutilated nervous system, as certainly as his beliefs when sane signified evolution going on in an entire nervous system.

I can now consider the other degree of post-epileptic insanity, mania. Manifestly, the mental condition is duplex; the patient is "unconscious" (significant of dissolution) as well as furiously acting (evolution going on). By artifice, speaking of layers (sub-levels) of the highest centres, I will suppose that his "unconsciousness" signifies loss of function of the highest two layers of his highest centres. This produces some universal or widespread paralysis, but less than that in post-epileptic coma, in which, a deeper dissolution, we shall imagine that the highest four layers are functionless. But the positive symptoms of the post-epileptic (unconscious and) maniacal patient are owing to over-activity of sensori-motor arrangements of the healthy third layer and of still lower layers of his highest centres; these layers, now his highest, are in great hyper-physiological activity, being uncontrolled by the normal highest two layers which have been suddenly rendered functionless. To say that there is some universal paralysis and yet universal activity is not contradictory. It would be a flat contradiction if it were said that all the patient's muscles were perfectly paralysed and at the same time in great activity. There is supposed to be loss of some movements of all muscles, with over-development of other movements of those same muscles. Let me consider the matter analogically. Often do we encounter cases of imperfect hemiplegia; here, although clinically we may say that the muscles of the limbs are weak, there is really loss of some movements of all the muscles of the limbs, with persistence of others of those same muscles. I can now consider the sensori-motor constitution of the nervous system more widely.

In order to make a proper comparative study of nervous diseases on a large scale we must reduce different symptoms to a common denomination. The widest assertion in accord with the hypothesis of sensori-motor constitution of the whole nervous system is, that negative lesions of every part of it produce paralysis, sensory or motor, or both, and nothing whatever else.

I will illustrate this dictum further, speaking, however, of motor paralysis only, by which I always mean loss of movements. The assertion made is not a mere truism. For instance, it may be said that negative lesions of the highest cerebral centres cause loss of consciousness. I have been urging that they produce paralysis. I admit that consciousness ceases or diminishes correlatively with loss of function in these centres; but this is not contradictory of the statement that the loss of function causes paralysis. So anxious am I to make out a good case for the sensori-motor constitution of the highest centres that I will state a comparatively simple example of artificially produced insanity, dementia, in a lower animal. When a rabbit's cerebrum is cut out the animal is demented. But movements of every part of its body can be evoked by appropriate incitations. Nevertheless, I declare that the animal is paralysed. It retains all simple movements represented on the lowest level of evolution, which is pretty much all that is left of its cerebral series. But I submit that it has lost all the more complex movements; all those it no longer makes—all those movements which, in the human subject, we should distinguish as the physical aspect of Conduct—and is, therefore, universally paralysed. Further illustrations must be given in outline and briefly. We ought to analyse symptomatology very carefully; the positive or super-positive symptoms in any case of negative lesion of any nervous centre cannot possibly result directly from that lesion. For example, the destruction effected by a tumour of the middle lobe of the cerebellum cannot produce the disorder of co-ordination which nevertheless is present in such a case. My submission is that this lesion produces paralysis only; this is first, I think, loss of some movements of the spinal muscles. The positive symptoms, the erratic movements of the legs by which the patient in an early stage of his ailment does somehow get along, are the outcome of over-activity of perfectly healthy nervous arrangements; these are doing more than their normal share of work. So that, comparing and contrasting such a case with one of hemiplegia, the things comparable and contrastable are not the "disorder of

co-ordination of locomotor movements" with the hemiplegia; the comparison and contrast are of two cases of paralysis, of loss of movements of the spinal muscles with loss of movements of the limbs. I submit that the formula describing all inco-ordinations with negative lesions of nervous centres is that there is, negatively, loss of some movements, paralysis (this alone being the result of pathological change), with, positively, forcing of some other movements of the same muscles. In saying this, the assertion I made early in this address, and repeated when stating the duplex condition in cases of insanity—that much of the symptomatology of nervous diseases is owing to activities or over-activities of healthy nervous elements—is implicitly reiterated. Now for other examples of paralysis from negative lesions of centres.

I believe that in what is commonly called tremor in a case of disseminated sclerosis, say of an arm, there is paralysis in the sense of loss of some movements of the limb; the tremor itself is owing to the fact that the excursions of the limb have to be effected by fewer, and presumably less fit, movements than normal. Observe there is loss of some and retention of other movements of the same muscles. The movements by which the limb does carry, although erratically, a cup to the mouth are not blameworthy; they are the best in the evil circumstances, the next best to the normal; they are produced, I suggest, by discharges of healthy nervous arrangements. Let me illustrate the principle involved by a very simple case, and this time by one in which the muscles are paralysed. When a man has paralysis of the extensors of the forearm, his grasp is weak and the hand moves clumsily in all its uses. But no one thinks of blaming the flexors for the weak grasp and for the clumsy operations of the limb; the flexors are acting faithfully; what they do is badly done because the extensors will not co-operate. So I suggest that, in the kind of tremor spoken of, the fault is that certain movements being lost they no longer co-operate with others which, being unaided, move the limb erratically; the real fault, what the pathological change causes, is paralysis. That a patch of sclerosis, if it be an absence of proper nervous elements, can cause any movements, good or bad, is an impossible thing; the tremor has, however, been ascribed to imperfect function of intact axis cylinders in the parts sclerosed. Now for another example. I have long held that the lesion in cases of aphasia produces paralysis in the sense of loss of complex, etc., movements of the articulatory muscles. It may, however, be urged that the articulatory muscles move well; so they do in simple operations, but they never move so as to make articulations (syllables). I have so recently dealt with this matter¹⁸ that I will say no more of it. I will, however, allude to what I said of Semon and Horsley's experiments on the representation of the vocal cords in the cortex. These experiments demonstrate that in one case at least there may be loss of some movements of a muscular region, with persistence of so many other movements of that region that no disability in the working of the muscles is discoverable. (These experiments are a strong confirmation of Broadbent's well-known hypothesis, for one case at least.) There are other cases in which paralysis exists in which it is not expressly thought of. In cases of pernicious diabetes the lesion is supposed to be of a certain part of the great vasomotor centre; if so, then what the disease (pathological process) produces is nothing but paralysis of the hepatic arterioles. Speaking figuratively, the medulla oblongata knows nothing of glycogen or sugar; it only knows the hepatic arterioles. Thus, in a scientific classification, pernicious diabetes is a paralysis from lesion of a part of the spinal system (lowest level of evolution of the central nervous system) as certainly as that ordinary progressive muscular atrophy, or anterior-polio-myelitis, is. I suggest that the xerostomia ("dry mouth"), first described by Hutchinson, and soon afterwards by Hadden, is also a paralysis—that it is owing to a negative lesion of the centres for the motor nerves of the salivary and other oral glands.

I submit that the essential thing, that which disease, in the strict sense of pathological change, produces, in cases of insanity, "disorders of co-ordination" with negative lesions, tremor, aphasia, pernicious diabetes and xerostomia is paralysis. This way of looking at cases is most important when we are engaged in the comparative study of nervous diseases, and especially of insanities (diseases of the highest level) with diseases of the lowest level.

I will now give a series of fragmentary illustrations, largely hypothetical, of losses of some and persistence of other move-

ments of the same muscles, the movements lost and those persisting varying according to the level of evolution damaged. I submit the hypothesis that (1) progressive muscular atrophy, (2) paralysis agitans, and (3) general paralysis are homologous diseases. The comparison and contrast is not of wasting of muscles, tremor, and a negative psychical defect. Analysis shows, I think, that, artificially limiting illustration to the hand, there is loss respectively of (1) simplest, (2) more complex, and (3) most complex movements of the hands. The comparison is of three cases of paralysis. The lesion is supposed to be wasting of cells, in the order from smallest towards largest, of lowest, middle, and highest motor centres respectively. The cases differ according to the level of evolution morbidly affected. Referring back to what was said on the hierarchy of motor centres, I now go into more detail.

1. In progressive muscular atrophy there is loss of simplest movements of the hands (cerebral and cerebellar), of those represented in some of the lowest motor centres (anterior horns). In this case the muscles are cut off from the influence of the whole central nervous system and waste. It is important to note that there is retention of more complex (middle centres) and most complex (highest centres) movements of the hands, certainly of motor nervous arrangements for them. Did not motor nervous arrangements still representing the hand remain in the highest centres, the patient could neither think nor dream of moving the part, and would have no physical basis for tactual ideas.

2. In paralysis agitans there is (this is, of course, hypothetical) loss of more complex movements of the hand, those represented in the middle motor centres. There is retention of the most complex movements represented in the highest motor centres, and also of the simplest represented in some lowest. With this loss of more complex movements (we might say "middle movements") there is, in the tremor, development of simplest movements of the same muscles, the latest stage being rigidity. I submit that these movements are the result of mere physiological over-activity of the healthy lowest motor centres. To repeat, there is a duplex condition of the hand; negatively loss of complex (middle) movements of its muscles, and, at the same time, super-positively, over-development of simplest (lowest) movements of the same muscles. This case (2) differs doubly from (1), for in (1) the movements lost are (a) simplest, and (b) both the cerebrum and cerebellum are cut off from the muscles, whilst in (2) the movements lost are (a) more complex, and (b) the cerebellum remains united through the lowest motor centres with the muscles. (I have suggested that the cerebellum co-operates with the anterior horns in producing the tremor.)

3. In general paralysis there is loss of some of the most complex ("finest") movements of the hands, those represented in the highest motor centres, of those entering into the physical bases of tactual ideas and of other mental states. Here there is retention of less complex (middle) and of simplest (lowest) movements.¹⁹

Of course the negative psychical defect in general paralysis is wider than that answering to loss of motor elements in the highest centres representing the hand. I have been artificially limiting the illustration. Yet if Spencer be right in saying that all other ideas have to be translated into tactual ideas, to lose tactual ideas is to become imbecile. I will here make further remarks on the negative mental defect in cases of general paralysis. I ask you to bear in mind the suggestion that the positive mental symptoms in this insanity, as in all other insanities, correspond to activities of healthy nervous arrangements; if so, we have nothing to do with them at the time when we are dealing with the effects of pathological processes.

Most mentation is carried on in visual and tactual ideas, and by aid of words. To have negative affection of consciousness is therefore to have especially loss of these three—I shall limit consideration to them—and thus it implies that there is correlatively a negative state of their sensori-motor bases. In general paralysis the lesion, if of the highest motor centres, is of the motor elements in those sensori-motor nervous arrangements—is loss of more or fewer of the most complex ocular, manual, and articulatory movements; the lesion therefore produces paralysis in the sense of loss of "finest" movements of the three parts. I submit that, taking an early stage of general paralysis, the tremor of the hands is indirect evidence of loss of most complex movements of these parts, and further evidence is the lack of dexterity in manipula-

¹⁹ Of course I do not mean that the lesions in general paralysis are limited to the highest motor centres. I am dealing with what I suppose to be the effects of lesions of those centres in this disease, and am taking but one fragment of these effects in illustration. Moreover, general paralysis is not a well-defined clinical entity.

tion. Similarly for the defective articulation. Now for paralysis corresponding to loss of visual ideas; in these ideas most of all mentation is carried on. Here I admit a discrepancy. It is said that there are no abnormalities in ocular movements in general paralysis; but I think that there is, in some cases, a want of even gliding of the eyes in their different excursions. I say this diffidently, and, instead of founding anything on it, will admit that I can show no evidence of paralysis answering to loss of motor elements of the physical bases of visual ideas in cases of general paralysis. (The pupillary inabilities in this disease are presumably owing to lesions of lowest motor centres.)

ADDRESS IN SURGERY,

BY

T. PRIDGIN TEALE, M.A., F.R.C.S., F.R.S.

DETAIL IN SURGERY.

In deciding what line of thought to select for this address, I had to consider whether, following the example of many of my predecessors and of the earlier retrospective addresses, to give an account of recent advances and changes in surgery, or to select some definite subject perhaps not entirely in accordance with precedent.

Happily my immediate predecessor devoted his address to a review of the surgery of the last half-century, absolving me from the obligation to adopt a similar course, and setting me free to choose a subject more congenial to my habit and work.

"Detail in Surgery" is the title selected for this address, in which I hope to show how much some of the triumphs and shortcomings of modern surgery are made or marred by the carrying out of detail, detail which is essentially embodiment of principle, not the mere multiplication of points of practice such as may not materially further the end in view.

In working out this line of thought, I hope to be able profitably to employ the time at my disposal, and to give prominence to conclusions which have been formed during a surgical life of over thirty years, made up not of my own work alone, but very largely of the freest interchange of thought and experience with most friendly and active-minded colleagues, medical and surgical, with whom it has been my great happiness to be associated. In so doing, it has been my endeavour to be as little egotistical as is compatible with the attainment of the end in view.

LIGATURE OF ARTERIES.

It happened not long ago that I had to deal with a wound of the brachial at the bend of the elbow. Esmarch's tourniquet enabled me to expose beautifully to the eye a longitudinal slit in the artery. Of course I was obliged to apply a ligature on both sides of the puncture. There were then clearly exposed to view the two ligatures and about half an inch of the artery containing the slit. It occurred to me to divide the artery between the ligatures, and so to relieve obvious tension. I then appreciated what I had never before fully realised in connection with ligature of an artery, the immense elasticity of the arterial coats. The separated ends receded fully half an inch from one another. The question at once occurred to me, Can it be right ever to tie an artery by a single ligature, and to leave this powerful force of elasticity to work for ulceration of the coats and gaping of the ulcer, with the risk of final disturbance by retraction of the divided ends when ulceration has completed its work? May we not here find an explanation of the numerous failures of ligature of the great arteries of twenty and thirty years ago, and of the fatal secondary hæmorrhages, chiefly from the distal end? Some may say that antiseptics and the cutting short of the ligature have changed all that, have reduced the risk of ulceration of the coats of the artery and of secondary hæmorrhage. Well, antiseptics fail now and then; and if they should fail we may be thankful for the additional protection of a doubly-tied divided artery. Secondary hæmorrhage and fatal result will be thereby rendered extremely improbable. Recently I assisted my friend, Mr. R. N. Hartley, in a case in which he first ligatured the femoral

and, a week later, the external iliac on the same side in the same patient. On both occasions he doubly tied and divided the artery with admirable result. This principle, proposed by Abernethy and afterwards forgotten, has recently been restored to practice at St. Bartholomew's Hospital by Mr. Walsham, and is, I believe, practised elsewhere. May we not call this "a detail" in the operation of tying an artery? Does it not embody a principle—the principle of physiological rest? Are we to recognise and act upon the fact of the elasticity of an artery or are we to ignore it, and to place our patient at the mercy of elastic drag, tension, ulceration, retraction when liberated, and secondary hæmorrhage? Does it not also involve the larger principle of *rest* as an important factor in the healing of any tissue?

STRICTURE.

There is a form of instrument for the treatment of stricture which has been but little written about and, although at last slowly making its way into use, has not met with the attention which I feel sure it deserves. It is known to me by the name of "Lister's sound," and was invented by Sir Joseph Lister.

From the very commencement of my professional life I have been familiar with and have been taught to use in the treatment of stricture "bulbed" steel sounds, which seem to have existed as traditional instruments in the Leeds Infirmary, were constantly used by my father and the older surgeons, and were, I believe, brought to Leeds by the late Mr. Samuel Smith, who had learnt their use from his master, Sir Charles Bell, in Edinburgh. The virtue of the bulb is this: that, the stem of the instrument being necessarily smaller than the bulb, as soon as the bulb has passed through the stricture the instrument is free, and the touch of the surgeon is at liberty to perceive the character of the succeeding part of the urethra. Compared with the bulbed sound, the ordinary catheter which, as a student, I frequently witnessed in use in the treatment of stricture was clumsy and eminently unsatisfactory. The defect of the bulbed sound in common with most other methods of treating stricture, was that as soon as one size had been passed through a stricture, the same process of difficulty had to be encountered in passing the size larger. Some twelve years ago, whilst I was considering how to overcome this difficulty, our house-surgeon, Mr. Rowell, on his return from a visit to Edinburgh, said to me: "Here is the instrument you want, a Lister's sound." I ordered a set, and I have used them ever since, exclusively, and have never flinched one moment from my allegiance to them. The principle of the instrument is this. It is bulbed at the point, like our old bulbed sounds. Then after the narrow neck the stem gradually increases until it attains, at a point about four inches from the bulb, a calibre two sizes larger than the bulb. Thus: No. 1 at the bulb swells to No. 3 or 4; No. 9 to 12; No. 11 to 14. It is clear then that if you can once pass No. 1 safely into the bladder, you have prepared the way by the thickness of the stem for the more easy introduction of a sound with a bulb of the size of No. 2, and so on, each number passed rendering the way more easy for its successor. As a matter of fact, the larger sizes are passed with constantly increasing facility.

Have we not here a "detail" in the form of an instrument which solves many difficulties, combining the advantages of the bulbed sound with those of the conical sounds and bougies, and avoiding the disadvantages of both? It destroys the need of catheters with the hollow eye capable of carrying concealed poison, of gum-elastic catheters, and catgut bougies with the possibility of septic material lurking in interstices and cracks, and reduces very greatly the need of perineal section or internal urethrotomy.

Let me sum up my own experiences of the use of Lister's sound, which for the last 12 years has been, both in hospital and private practice, most satisfactory. Since their adoption, as far as I can recollect, I have only once had to perform perineal section from inability to get through, or to satisfactorily dilate a stricture. I have never performed internal urethrotomy, nor felt the need of it. Rigors are extremely rare after the use of Lister's sounds. This rarity of rigor I am inclined to attribute to the fact that in nearly every instance dilatation has been carried at the first sitting, up to 10, 11, or 12. It is my belief that full dilatation at the first sitting is safer than the older method of partial and gradual dilatation, and for this reason. Even in partial dilatation there is frequently some laceration or bruising of the surface at the strictured point. If the stricture be only partially dilated, there remains a narrowing at this sore point sufficient to materially arrest the flow of urine, and therefore there is urinary