On Failure of Brain Power

By Julius Althaus

ON
FAILURE OF BRAIN POWER.

Salem N. Jersey

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FAILURE OF BRAIN POWER

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(ENCEPHALASTHENIA);

Its Nature and Treatment.

BY

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PREFACE.

WHEN a medical book which is not a Student's Manual reaches a fifth edition, it must be allowed to have filled up a hiatus which had existed in medical literature. Such a fact naturally imposes on the author the obligation to revise his work with particular care, and to endeavour to the best of his ability to keep it up to the ever-advancing tide of medical progress. I trust that I may not have failed in this; and I have added a new chapter on the intimate structure of the brain, as revealed by the most recent anatomical researches. These latter have enabled me to give a further development to a theory which I have held for a considerable time, viz., that the action of the nervous unit or neurone, with its cell, its axone and its dendrites, is of an electrical nature. An absolute proof of the correctness of this theory can only be given by special work in the physiological laboratory; and I hope that this necessary corollary may soon be achieved by one who may be particularly qualified for scientific work of that description.

The therapeutical results which I have obtained in the neurosis under consideration, with the aid of electricity applied to different areas of the brain, have become more striking in proportion as the methods of using that agent have become more fully and definitely elaborated; and I entertain no doubt that my results will in every instance be confirmed by those who will take the trouble of following the plan of treatment I have laid down in the last chapter of this book. As with the increasing changes in our habits of life the neurosis under notice is constantly becoming more frequent and apparently more severe, while it is so often found rebellious to purely medicinal and hygienic measures, I trust that the methods of electrical treatment which I have recommended for it, and which experience has proved to be highly beneficial, may be found to constitute a distinct advance in therapeutics.

26, QUEEN ANNE STREET, W.,
March, 1898.

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ON

FAILURE OF BRAIN POWER.

FAILURE of brain power is one of the most frequent disorders nowadays met with in practice, but it is often not properly recognised, and very often improperly treated. It may be said to exist where there is an absence of sustained mental and physical force, with deficient power of resistance to unfavourable influences acting upon the individual; where fatigue of body and mind is too readily induced by comparatively slight efforts; where sleeplessness, depression of spirits, exaggerated introspection, and morbid feelings of terror and alarm disturb the tenor of life; where pressure on the head and an immense variety of other distressing sensations are commonly experienced; and where in spite of all such and other symptoms, which will be presently fully described, there is yet no organic disease of the brain to which these troubles could be referred. Functional or nutritional disorders of this kind have unquestionably always existed, more especially at times when civilisation had reached a high standard, when there was great political or religious excitement, and during wars, famine, and the prevalence of epidemics. In our own time, however, such affections have become particularly frequent and severe, owing to the profound changes in the general conditions of life which have taken place of late years.

1. A powerful influence in this direction has been the large *increase of population* which has occurred during the present century. This has led to a greater disproportion between the number of people and the necessaries of life, which latter are

nowhere scattered in profusion, but are always more or less limited. The competition for necessaries, comforts and luxuries, that is, the *struggle for life*, has, therefore, more especially in our own time, become much more severe than it ever was before. Darwin has shown that this struggle goes on amongst all organised beings: in plants, which compete with each other for sunshine and moisture; in animals, which compete for food and sexual pre-eminence; and in men, who compete in all the different branches of human activity.

2. Another influence which has further intensified the competition already existing I consider to be the *decrease of religious feeling*, and of a belief in a future life, which was to redress the inequalities and apparent injustice of the present. Those who no longer believe in the immortality of the soul are now generally profoundly dissatisfied with existing conditions, and show themselves particularly keen in their avidity for the good things which make this present life of ours worth living.

3. Finally the inventions by means of which the forces of *steam and electricity* have been utilised for the ordinary purposes of life, the facilities for travelling, and the extraordinary development of the newspaper press, have completely revolutionised and transformed the mode of living which obtained in the time of our ancestors, and thereby greatly increased the calls which are habitually made upon the power and endurance of the nervous system.

The result of the action of these different causes has been that the pace at which we live has become much faster, and the clash of opinions and interests much keener than formerly, more especially in the ceaseless turmoil of great cities, to which by far the larger part of the population is now gradually being attracted. The fierce competition which at present exists, not only between the classes, but also between the sexes, nations and races, has led to a greater wear and tear of life, and entails more liability to a break-down of nervous force than was habitual in former times, when most people lived quietly and contentedly, far from the madding crowd.

In this *bellum omnium contra omnes*, which Malthus foresaw with a prophetic glance, it is only too natural that many unlovely features should come into view, and, in the fierce light which is now thrown upon everything, attract more attention than they perhaps deserve. Thus we are often struck by the excessive avidity displayed for the acquisition of wealth, and the feverish desire for amusement exhibited by so many persons.

The reverence of children for their parents, which is the base of all that is good and honourable in life, appears to have perceptibly declined. Many children adopt the American custom, and treat their parents with a kind of supercilious condescension. Young men entertain exaggerated notions about what is due to them, and will not be satisfied with anything but complete license. By their reading and their contact with modern life, they acquire "advanced" ideas; they feel all the fermentation of the period at work in them; their nervous system is unduly excitable, they are eaten up with selfishness, and rebel against the existing order of things. They are incapable of sustained effort or serious application, change from one walk of life to another, and give each up in turn as soon as the first difficulties present themselves; yet they continue to indulge in tall talk, and think that they are the cream of the age. They soon drop out of the race, and have nothing left but dislike and contempt for others, and hatred against a society which they consider out of joint. Other young men embark in wild speculation, and lose their own and other people's money, or join the ranks of Anarchists and Nihilists.

Many girls, on the other hand, aspire to be "new women," and dream of gaining a brilliant position in the world, either by their beauty or their talents. They feel sure that they can make a name for themselves in history, and are intended for great deeds. In order to accomplish them, however, they consider it indispensable to lead an unfettered life, to be children of their time, and free to act as they understand it. They detest the absurd prejudices of a decrepit society, and do not want to marry, but to keep all men with whom they may come in contact, subject to their charms. While flirting rather strongly, they make it understood that they are guided by the highest principles. They mostly lead utterly useless lives, eventually become bored to death with everything, and end not unfrequently in mysticism or insanity.

Persons of this kind cannot be looked upon as an improvement upon the last generation, which may have been a little heavy, yet conscientious, hard-working, and practical. Fortunately, however, such cases as I have just described are by no means the rule amongst us ; and I take it that evolution is, on the whole, working satisfactorily, and in the right direction.

In the struggle for life some are favoured from the very beginning and throughout their career by advantageous external conditions, and even more so by having inherited a healthy and well-organised brain from their ancestors ; for man's brain is his most powerful and terrible weapon. Others again are handicapped by finding unfavourable conditions on starting in life, and by an inefficient or fragile nervous system. The fittest must therefore survive and flourish, while the weak must suffer, break down and perish ; and this natural law, however sad may be its operation in individual instances, must, on the whole, prove beneficial to the race, which will thus gradually become more perfected by selection. I therefore do not hold with those who fear that the majority of people will presently be unable to bear the strain of life, and hopelessly deteriorate in their higher faculties ; on the contrary, I believe that our capacities and powers will be gradually increased in proportion to the higher claims made upon us, and by the clearing off of those who are inefficient. At a time when we hear so much about "degeneration" (Max Nordau) and "dry-rot" (Wo Chang), and when evidence for this is even found in the practice of adjourning for afternoon tea at a cricket match, it is consoling to see in the passing events of the day, such as the fighting on the Indian frontier, in the autumn of 1897, that whatever may be the fate of the decaying Latin nationalities, the Anglo-Saxon race, at any rate, still shows evidence of vigorous life. The British, whose character is formed by a happy blending of Norman initiative and adventurous spirit, with Saxon grip and endurance, are still

> "Strong with the strength of the race,
> To obey, to command, to endure;"

while science and the arts of peace and war have never flourished more abundantly in Germany than in the present day.

Again, to take a single class, with whom I have had an extensive and intimate acquaintance during the last forty years, viz., the medical profession of this country, together with their appendages of hospital matrons and sick nurses, I feel bound to state that an immense and steady advance has taken place in all our ranks during that period, not only as far as knowledge, but also skill, character and sense of duty are concerned.

As the nervous system has always had to bear the brunt of the battle of life, it follows that failure of brain power cannot be a new disease, as has been asserted by writers apparently but slightly acquainted with medical literature. Indeed, we find indications of a knowledge of it in the works of Hippocrates. Later on Willis, Sydenham, Whytt, Brown, Pridgin Teale, John Marshall, and others in this country; Tissot, Lallemand, Villermain, Valleix, and others in France; and Jaeger, Horn, Henle, Griesinger, Wunderlich, Hasse, and others in Germany, have devoted considerable attention to this disorder, which has from time to time been described by the names of hypochondriasis, nervousness, cerebral irritation, spinal irritation, spinal debility, nervous marasmus, general neuralgia, convulsibility, nervous erethism, neuropathy, and others. More recently Bouchut[1] made an able study of this condition, and termed it "nervosisme" (1860), while Beard,[2] who was unacquainted with Bouchut's and other writings on the subject, investigated the matter independently, and believed that he had discovered a new disease, for which he coined the word "neurasthenia" (1869), which rapidly became popular. In the first edition of the present work, which appeared in 1881, I called the affection "failure of brain power," and this still appears to me the most appropriate name for it. I then recommended, amongst other remedies, a special treatment for some forms of the malady, which I had used for a number of years past and found most efficient, and which has stood the test of time and much further experience, viz., the application of electricity to different portions of the head, in accordance with the origin of different forms of trouble from loss of power in corresponding areas of the brain. Since then a very large literature has sprung up on the subject, the principal works being those of Krafft Ebing,[3] Bouveret,[4] Franz Carl Müller,[5] Löwenfeld,[6] and Binswanger.[7]

Before entering into a description of the malady, however, I consider it advisable to give a short survey of recent researches on the intimate anatomical structure as well as the functions of the different portions of the brain. Our knowledge in this respect has made gigantic strides of late, and what follows will, in my opinion, facilitate the comprehension of the pathological and clinical facts with which I purpose to deal in the present volume.

CHAPTER I.

THE STRUCTURE AND FUNCTIONS OF THE BRAIN.

THERE is still considerable divergence between the foremost anatomists, physiologists, and pathologists of the day with regard to many points connected with this subject, yet all observers are agreed that the brain is the supreme controller of all our functions, and the source of all our powers; for after the removal of both cerebral hemispheres in warm-blooded animals, and in extensive brain disease of a destructive character in men, all mental operations, all signs of intelligent volition, as well as purposive movements, are annihilated; while destruction of the lower centres, more especially the pons and bulb, annihilates not only every function of the viscera, but life itself. It has, however, taken the work of more than twenty centuries to establish these simple facts; and a short historical retrospect of the development of our knowledge of this subject may, therefore, be of interest.

We are inclined to look for the dawn of all knowledge in those nations which first arrived at a certain degree of civilisation; yet we fail to trace any germs of brain-doctrine amongst the old Indians and Egyptians. The dreamy, imaginative Hindoos felt no temptation to unravel Nature's secrets by a laborious and repulsive dissection of viscera; while the Egyptians, whose minds were habitually clouded by gloomy forebodings, were inclined to look upon the natural forces as phantoms, which inspired them with awe. It is true that they opened the dead body for the purpose of embalming it; but this did not lead to any anatomical or physiological researches, and only produced the mummy—an image of petrified life, well representing the general character of the people with whom it has always been identified. It was only in ancient Greece, where the natural development of mental culture proceeded, unfettered by external or internal restraint, that men began to study form and shape, as well as vital function, and endeavoured to recognise the intimate and mysterious union existing betwixt the two.

It is instructive to find, even at that early period, two opposite parties working on the same subject in different ways, and arriving at altogether contradictory conclusions, as has been the case more or less ever since. Philosophers loved to indulge in free speculation and deductive reasoning, and laid down the law on the functions of an organ, of the structure of which they knew nothing; whilst physicians founded their opinions on clinical observation of injury to, or disease of, the brain, showing how the working of the mind and body was impaired through such occurrences. We can thus understand how it happened that such great thinkers as Plato and Aristotle committed themselves to fanciful and inaccurate theories, while Hippocrates and his successors were considerably in advance of the philosophers of their own time, as well as of many succeeding generations, in their insight into this intricate subject. Thus Aristotle stated that only the heart, being a unity in itself, could be the seat of the soul, which was likewise a unity; while the brain, being divided into two halves, could not be the seat of a single being, more especially as its connection with the organs of sense was only apparent. He found the organ of sensation, as well as of life itself, in the heart, which was the first organ formed in the fœtus; and he looked upon the brain as a part intended to cause sleep, and to regulate the temperature of the heart! Hippocrates, on the other hand, had already taught, long before Aristotle, that certain diseases of the mind, such as mania and melancholia, depended upon derangement of the brain. Polybos, his son-in-law, plainly stated in his work, "On the Sacred Complaint" (epilepsy), that the brain was the centre of the nerves, and the exclusive organ of the mind; and Erasistratus, of Alexandria, in the third century B.C., maintained that the superior mental powers of man were owing to the variety and complexity of his cerebral convolutions, which were more considerably developed in him than in any animal.

With the decline and fall of ancient Greece the passion for speculation and the pursuit of science was extinguished. Natural philosophy, which had only just commenced to flourish, was embalmed in the libraries of Alexandria, and was afterwards transferred to Rome, where it remained, however, an exotic, and was only scantily appreciated by the mistress of the world. The sum total of previous knowledge is found expressed in the writings of Galen, which authoritatively determined the direction of science for many centuries. He stated the brain to be the seat of thought and action, and believed its structure to be identical in the lower animals and man. He thought that it was composed of two halves, in order that one side might still continue to act after injury to the other, and that the soul resided in the ventricles of the brain. This theory was further developed by his followers, and Nemesius taught that the imagination resided in the anterior cavities, the thinking powers in the middle, and the memory in the posterior ventricles of the organ.

For more than a thousand years after Galen no real progress was made in our knowledge of this subject. Mankind appeared to be seized by a kind of fever, which was only much later recognised as an evolutional disease. Science could not flourish where barbarians ruled, where blind superstition overawed the people, and the yoke of princes led to unquestioning submission to authorities.

When the Arabs, led by Mohammed, reached the highest pinnacle of their political power, they received with deference European learning, the monuments of which they had conquered in Egypt and Greece; yet neither anatomy nor physiology could thrive amongst the followers of Islam; for religious precepts prohibited them from dissecting; and the singular mixture of fatalism, enthusiasm, and inertia, which was the distinctive feature of their character, was unfavourable to scientific pursuits.

At last the inherent power of the European races overcame the tedious illness which had prostrated them so long. The struggle against the supremacy of the Church of Rome and literary authorities; the renewed study of Greek classics; the voyages of discovery, and the progress in the useful arts, were all so many symptoms of a fresh upheaval of mental energy. The era of the Renaissance began in Upper Italy, where the emulation of the smaller States, the republican spirit in them, as well as the support given by liberal-minded princes, electrified the minds; and Bologna, Padua, and Pisa became the high schools of anatomy for the whole of Europe.

The crisis in anatomy was brought about by Vesalius[8] (1542), whose passion for research was such as to subject him to great troubles and dangers, when attempting to procure bodies for dissection. At that time it was looked upon as blasphemous to mutilate human remains, and physicians and surgeons derived their anatomical knowledge from the dissection of dogs and monkeys. Vesalius was only twenty-eight years of age when he published his great work on anatomy, which, according to the saying of his contemporaries, laid a new world bare. He was the first to distinguish the white and grey matter of the brain, and described its general configuration more accurately. His teaching created the greatest excitement in the Italian centres of learning, and his merit was appreciated by the Emperor Charles V., and Philip of Spain, to whom he acted as physician; yet his brilliant career was cut short by the Inquisition, and he was drowned on returning from a pilgrimage to Jerusalem, which had been forced upon him in order to get absolution. His work stirred up a host of eager successors, amongst whom Varoli[9] of Bologna (1575) was one of the most illustrious. Although not persecuted like Vesalius, he had to suffer throughout his career from the meanness and envy of ill-natured detractors, and died at the early age of 33. He first described that portion of the brain which is now known as the "Pons Varolii," and examined carefully the base of the organ. He maintained that the soul resided in the substance of the brain, and that the theory assigning "the spirits" to the ventricles was a deceit, owing to a bad use of the organ which the Almighty had given to man for the purpose of thinking. According to him the substance of the hemispheres represented the images of things symbolically, disembodied from all things corporeal; the ventricles did not contain air, but serum, and this latter served for eliminating the products of decomposition which were formed through the action of the brain.

A great step backwards in our knowledge of the functions of the brain was made by the philosopher Descartes,[10] who disregarded Varoli's teaching, and maintained that while the animal spirits resided in the ventricles, the soul, being a unit, was in contact with the body in the *pineal gland*, or conarium, or epiphysis cerebri, which is situated at the entrance of the ventricles; and that the spirits were the means by which intercourse was carried on between the pineal soul, and the sentient and motor nerves originating in the walls of the ventricles. It is now well established that the pineal gland is one of the few portions of the brain which have nothing whatever to do with thinking or feeling. Indeed, as early as 1695, Ridley[11] remarked that Descartes' "sublime and most deservedly admired philosophy would doubtless have been much more useful had he conversed more with dissections, and less with things invisible;" and Nuck[12] maintained that those who suffered from gravel in the pineal gland during their lifetime, "were not any less wise than those with whom their gland was in its natural order; and that we were therefore quite justified in singing the funeral service of this gland." This view has been confirmed by the more recent researches of Hagemann[13] and V. Kupffer,[14] who showed that even in those cases where the gland had been found entirely degenerated or destroyed, no function in the body had suffered or ceased in consequence, so that its destruction was not productive of any visible disadvantage to the human system. It is generally admitted now that the pineal gland is a rudimentary organ, which in the lower vertebrates resembles an eye—the so-called parietal eye—but is in the birds and mammalia so shrunk and wasted that no trace of the structure of an eye can be discovered in it. Kölliker[15] considers the pineal gland of man to be entirely devoid of nerves, while Ramón y Cajal[16] states that not a single nerve-fibre enters the gland from the peduncles, but that in the interior of the organ a considerable number of ramified nerve-fibrils may be seen, forming a plexus which resembles that of other glands. However this may be, it is quite clear that such a rudimentary organ cannot possibly have such an important function as was attributed to it by Descartes; and it therefore seems almost incredible that certain philosophers should be found even at the present day to adhere to Descartes' exploded notions on the subject. While, therefore, Descartes' writings did much to set investigators on the wrong track, as far as the functions of the brain were concerned, yet he did good by laying stress on the fact that no scientific psychology was possible without a knowledge of the structure and functions of that organ; besides which he was the first to give a correct description of reflex movements, and to discover the law of the eccentric projection of sentient impressions.

The next great name in this branch of science is Willis,[17] of

Oxford (1667), who dissected more neatly than his predecessors, and first injected coloured liquids into the blood-vessels, so as to show their ramifications in the cerebral substance. He also began to make use of the data furnished by comparative and pathological anatomy on this point; published drawings of the different portions of the brain, of which he discovered several important parts, which had previously been overlooked; and described the nine pairs of nerves which arise from the base of the brain. Stenson,[18] who wrote in 1671, remarked that notwithstanding the great advances which had been made in our knowledge of the brain, the human mind, which had carried its investigations right into the heavens, had not yet been able to comprehend the nature of the instrument by which its own operations were performed, and that its powers seemed to abandon it as soon as it turned its attention to the organ in which it resided.

Malpighi[19] (1687) who taught in Pisa, Bologna, and Messina, was the first to use the microscope for ascertaining the more intimate structure of the brain, and found the white matter to consist of delicate tubes or fibres.

The Dutch, who owed liberty, wealth, and the very soil on which they lived, to their extraordinary working powers, had, at that period, raised their country to the first rank amongst the nations, and undertook chiefly such investigations as require ceaseless industry and application, and where the smallness of the objects examined appeared to put insuperable obstacles in the way of enquirers. With the aid of the microscope they discovered hitherto unknown structures, and prepared specimens which are even now worthy of admiration. Swammerdam[20] first described the middle tunic or arachnoid membrane of the brain; and Leuwenhock showed the grey matter to consist of very fine globules. Ruysch perfected the art of injecting the blood-vessels with coloured liquids, and of preserving specimens. He hardened the brain in a kind of balsam which he invented and kept secret, and furnished preparations which are even now in a state of perfect preservation.

About the same period France entered the lists, and Louis XIV., desirous to add to the brilliancy of his reign, gave ample support to scientific institutions, such as the Paris Academy of Sciences; yet surgery was more successfully cultivated by the French than anatomy. In the commencement of the eighteenth century, however, François Petit made several discoveries in the anatomy of the brain, showing for instance the decussation of the motor tracts in the bulb, a fact of capital importance.

The Germans manifested at that time more industry in collecting facts discovered by others than original research; and the first truly great Teutonic name in this science is Albrecht von Haller,[21] who brought all previously acquired knowledge into one common focus, compared the brain of birds and fishes with that of man, and gave a fresh impetus to physiological enquiry. Prochaska[22] and Soemmering[23] followed in his footsteps; while Gall,[24] in the commencement of the present century, added largely to our knowledge, and greatly improved the methods of examination. Instead of simply cutting up the structures, he steadily pursued the course and connections of the fibres, and was thus led to a number of discoveries regarding this important point. He also showed conclusively that the convolutions of the brain are the principal base of mental activity; but was less fortunate in erecting the unstable edifice of phrenology, for he completely failed in proving his chief point, viz., that external bumps on the skull corresponded to equivalent portions of the brain's surface. Reil, of Halle, undaunted by the persecution of the first Napoleon, who suppressed that University, followed the better way of careful dissection, and discovered the "insula," which Flechsig[25] has recently claimed as a mental centre. Carus,[26] of Dresden, traced the gradual evolution of the brain in the animal kingdom from its lowest beginnings. Tiedemann,[27] of

Heidelberg, investigated the development of the organ through every month of human embryonic life. Stilling,[28] a general practitioner at Cassel, in Germany, invented the method of making very thin sections through the frozen brain, which he had exposed in winter out of doors at a temperature of -13° R. (January, 1842). Hannover,[29] of Copenhagen, was the first to harden the brain with chromic acid and chromates; while Gerlach,[30] of Erlangen, introduced staining by carmine (1858). Lockhart Clarke[31] advised the use of alcohol for removing the water from the brain, and rendered his sections transparent by essential oils; and Ranvier,[32] Key, and Retzius,[33] and many others, greatly enlarged our anatomical knowledge of the myelinated nerve-fibre.

A considerable improvement in the method of examining the nervous structures was introduced by Weigert (1886),[34] who substituted the hæmatoxylin for the carmine dye. This method rendered it possible to recognise the myeline sheath of the nerve-fibre in its most attenuated form, and to trace not only the course of individual strands of fibres in a more accurate manner than before, but also to recognise the arrangement of white and grey matter more clearly, while in morbid anatomy it plainly disclosed the course of degeneration which had taken place in nerve-fibres.

In spite of all these researches, however, the most important questions remained unsettled, as nothing definite was known about the relations of the brain cells to each other, nor about the origin and termination of the nerve-fibres in the nervous centres.

A new era in this line of research was inaugurated by the Italian anatomist Golgi,[35] whose first publication in 1873, however, appears to have been overlooked. It was not until 1886 that his larger work on the same subject[36] attracted the attention and commanded the admiration of anatomists throughout the world. About the same time another useful method of staining by methylen-blue was proposed by Ehrlich.[37]

Golgi has described three different methods—viz., a slow one, a mixed one, and a rapid one. He prefers himself working with his mixed method, while Ramón y Cajal, and almost all other anatomists, prefer the rapid one. This latter consists of the immersion of the parts into a solution of perosmic acid (1 per cent.) and bichromate of potash (3·5 per cent.). In this mixture they are allowed to remain for a few days, after which they are transferred into a solution of nitrate of silver (0·75 per cent.). Two days afterwards they are fit for use and embedded in celloidine, dehydrated by alcohol, and treated with oil of bergamot or cloves, for clearing them up. The chemical process which takes place is, that bichromate of potash is changed into bichromate of silver. ($K^2Cr^2O^7 + 2AgNO^3 = Ag^2Cr^2O^7 + 2KNO^3$). The advantages of Golgi's method are, first, that not only the medullary sheaths, but also the cells and their processes—viz., the axones and dendrites, with their finest ramifications—are stained by it; and, second, that the method has a selective tendency, inasmuch as not the whole of the nervous elements which are present assume the black colour, but only a few individual cells and fibres. If all the structures present were to be equally stained, only little would be gained, for the extraordinary complexity of the images produced would lead to confusion; while the way in which certain parts are picked out by the method, allows of a very perfect representation being obtained, not only of cells and their protoplasmic processes, but also of axones and their collaterals.

Golgi's method has been greatly perfected by the Spanish anatomist Ramón y Cajal.[38] The latter found that repeated exposure of the sections to Golgi's solutions gives better results than only one such immersion, and that too, whether the first preparations have been fairly good or unsatisfactory. A second procedure always gives more complete and perfect images than the first, and Lenhossék[39] even advises a third impregnation, which will often change failure into success. A still more important improvement, however, which was introduced by Ramón,[40] is that he investigated with preference the brain of the fœtus and of the newly-born animal, while Golgi had worked chiefly with fully-matured nervous structures. Sections of the fœtal brain are not only much smaller than those taken from adults, and therefore give a more comprehensive view of the structures in a limited space; but owing to not being thoroughly developed, the fibres and their processes are much more simply built up. A final advantage is that the fœtal nerve-fibre, being naked and as yet unprovided with a medullary sheath, is more readily impregnated with silver than the adult nerve-fibre, after it has undergone myelination; for the medullary sheath, when fully developed, forms an insoluble organic compound with the perosmic acid, which is used in the first stage of Golgi's method, and thus prevents a subsequent free access of the silver to the axone, which is therefore protected by an impenetrable layer. Preparations of fœtal nervous structures made with Golgi's method, far surpass in precision and clearness everything that had been formerly achieved.

A more recent method, which may serve to supplement Golgi's proceeding, is that of Cox,[41] which consists of perchloride of mercury being added to the bichromate solution. This also gives black images, but has no selective tendency, so that every structure which is present stands out completely revealed. While this is a drawback, in so far as it does not allow of the study of individual nerve-cells, in the same way as with Golgi, there is, on the other hand, the advantage of a more comprehensive view being obtained of the topographical arrangements of definite layers of cells and plexuses of fibres than in Golgi's sections. The method is not a rapid one, as from one to three months' immersion is required, according to the season of the year.

The histological results obtained by the aid of Golgi's method have been to a great extent confirmed and even extended by the degeneration method of Marchi, who has succeeded in laying bare, by his osmium-bichromate method, the strands of degeneration of afferent or efferent fibres, which come in view when the cortical area which is supposed to be their centre is destroyed.

Experiments on the Functions of the Brain.

One of the earliest experimental methods for ascertaining the physiological work done by the different portions of the brain was *ablation*, which was first practised by Flourens,[42] with the view of studying the symptoms which followed destructive lesions of these parts. He showed that loss of the hemispheres deprived an animal of everything which is known as perception and volition, but was led to the erroneous conclusion that all portions of the brain were of equal value. He believed that destruction of any portion of the hemispheres diminished mental, sensorial, and motor functions in the same degree, and that the loss of brain-power altogether was strictly proportionate to the quantity of cineritious matter which had been removed. Flourens' theory was for some time accepted by physiologists, but was contradicted by the discoveries of Gall,[24] Bouillaud,[43] and Dax,[44] who taught that aphasia was owing to a lesion in the left frontal area; while Broca,[45] in 1863, maintained that the integrity of the third left frontal convolution was essential for articulate language in all persons who use principally the right hand—that is, in 98 per cent.; while in the left-handed, or in 2 per cent., the corresponding part of the right frontal lobe was trained for language.

Flourens' method of research was followed by a host of other observers, amongst whom I will only mention Munk, Luciani, Albertoni, Tamburini, Bianchi, Horsley, Beevor, Schaefer, Frank, Pitres, and Bechterew; and there are grounds for stating that the interpretation of the phenomena observed after such ablations has occasionally been of a somewhat fantastic character. The most important experiments of this kind were made by Goltz,[46] who succeeded in keeping a dog alive from which the entire hemispheres had been removed, and who showed that such an animal was even then not absolutely deprived of all mental activity. It is true that there was no trace of memory or reasoning left, and that the animal was not able by means of his senses to find external objects necessary for the satisfaction of its bodily wants; yet it did not appear to be such an absolute automaton as Flourens had taught. That dog was able to run about, and keep the erect position. It showed signs of annoyance when pinched, or when worried by strong light or loud noises; it would get into a rage, bite, and howl when lifted up from the ground, and deprivation of food would cause vigorous movements of the body. After taking sufficient food, however, it would again become quiet and dull, and fall into an apparently dreamless sleep, from which it was in general only aroused when the feeling of hunger returned, or when external stimulants were applied.

Electrical Experiments

on the functions of the brain were first undertaken by Fritzsch and Hitzig,[47] who showed that, by the application of the constant galvanic current to the central convolutions of the dog, movements of certain parts of the body could be obtained. Ferrier[48] and others used with preference the induced current, and carried this method of research much further. These investigations will be fully discussed when the localisation of the cerebral faculties comes under consideration.

Clinical Observations.

Clinical observations and subsequent post-mortem examinations of cases of brain disease by such pathologists as Türck, Charcot, Kussmaul, Nothnagel, Hughlings Jackson, and others, likewise contributed largely to a better recognition of the functions of the several portions of the brain; and the diagnosis of local brain-lesions eventually became so perfected that it is now possible in many instances for the physician to guide the surgeon's knife with the greatest accuracy, so as to effect the removal of a tumour from the brain.

Developmental Researches.

A final and most important step towards the elucidation of the cerebral functions was taken by Flechsig,[25] whose researches on the myelination of the central nerve-fibre have opened up a new vista of the actual base of all our mental operations. By investigating the gradual and successive formation of the medullary sheaths of these fibres, Flechsig was able to recognise peculiarities of organisation in the brain, where other modes of research had encountered insuperable difficulties. He has shown that certain fibres and sets of fibres, which, in the adult, are so inextricably welded together that they seem to be identical, may be plainly distinguished from each other at certain phases of embryonic life, since some of them are then still naked axis-cylinders or axones, while others have already become clothed with a sheath. The lower level of the brain, consisting of the bulb and pons, is completely developed at birth; but the infant enters the world with altogether immature hemispheres, for the fibres of the latter are then quite naked, and devoid of myeline sheaths. The infant at birth may, therefore, be said to resemble Goltz's dog, from which the hemispheres have been removed, and at this period the lower wants of the system are but physico-chemical processes, without any mental character. When the blood is charged with carbonic acid the bulb is stimulated, and causes respiratory movements; and when water and solid constituents are required, the stimulation of the nervous system leads to vigorous movements of the body. As soon, however, as the physical wants of the infant have been satisfied by breathing and the taking of food, it relapses into unconsciousness and an apparently dreamless sleep. At this time of life there appears to be an almost total absence of lecithine, which forms the most important chemical constituent of the adult brain.

Matured bundles of fibres are, when stained with hæmotoxyline, seen to course in the newly-born infant together with immature fibres which do not take any staining, and consist simply of transparent glass-like axones, which can often be followed up for a very considerable distance. After the fibres of the bulb and pons have become matured, development is seen to set in in those parts which constitute the *sensory centres*. Conducting paths are thus formed which connect sentient parts of the interior of the body, more especially the muscles, and the organs of sense, with the grey cortex. The first sensory path which is seen to penetrate from the surface of the body to the hemispheres is the olfactory, which is so important for the selection of food, after which follow the tactile and visual spheres, while the auditory paths, as the least important at that period of life, come last. *The sensory areas of the hemispheres are thus seen to be the internal terminations of the sensory nerves*, and their destruction is known to be followed by cortical blindness, deafness, etc. All sensory spheres possess a corona radiata, by means of which they are connected with subcortical centres of the brain and cord. They contain not only the terminations of sensory paths, but also the cells where the motor paths originate, so that a sensory "field of projection" is always contiguous to the "motor field." There are therefore no *purely sensory* spheres nor *purely motor* areas in the cortex.*

* Hughlings Jackson has quite recently (*Brit. Med. Journal*, January 8th, 1898) expressed the same idea by stating that the so-called motor provinces are only *chiefly motor*, and the sensory provinces only *chiefly sensory*.

It is only after these sensory paths have become completely built up and myelinated that a new development is seen to commence in that much larger portion of the hemispheres which is not connected with the sensory nerves, and which has remained immature for several months after birth. Some of these paths course towards the lower levels of the brain, others towards the cord and the origins of the motor nerves, thus facilitating the transmission of volitional impulses to the motor mechanisms, and others again towards the nerves obeying the impulses, in the central ganglia, while each sensory centre shows in its microscopic structure a type corresponding to the terminations of the nerves of special sense which it represents. These latest cortical formations, which Flechsig has termed the *mental centres*, show a more uniform type of structure, and one which is no doubt closely connected with their function of proper interpretation and mental digestion of sensory impressions. The mental centres, which will be presently more fully described, consist of the frontal brain, which is situated immediately above the eyes; a large portion of the temporal and occipital lobes; a vast area in the posterior parietal region; and finally the insula of Reil, which is deeply concealed in the interior of the brain. All these parts eventually become mechanisms for associating sensory impressions of different kinds, and for performing true mental functions. Morbid irritation of these areas leads to confusion of thoughts and insane delusions, while their destruction, in general paralysis, is followed by loss of knowledge, experience, principles, and the higher sentiments, with inability to utilise the past, or to foresee the consequences of actions. The unity of cerebral operations is brought about by numberless conducting paths extending over many thousands of miles of fibres, and connecting, first, the different sensory centres with each other; secondly, the sensory with the mental centres; and, thirdly, the several mental centres with each other.

The Neuroglia.

The brain is built up of a framework and of strictly nervous matter. The former consists of the sheaths of the blood vessels which traverse the organ, the cells of the ependyma, and the neuroglia, or glia, which is a tissue peculiar to the nervous centres, and not found anywhere else, except in the optic nerve.

The glia is composed chiefly of peculiarly stellated cells, which were first accurately described by Golgi, and are therefore called Golgi's cells. They consist of protoplasma and a nucleus, and send off numerous fine filaments of variable size, some of which are short and break up extensively into branches, while others are long, and do not ramify much. The number of such processes from each cell varies from five to twenty-five, and they form an intricate network, which fills up all the spaces between the nerve cells and the larger nerve fibres and blood-vessels, and which is most abundantly developed on the whole external and internal surface of the brain.

Most laborious investigations into the intimate structure of the neuroglia have recently been made, chiefly by Retzius [49] and Weigert. [50] The latter has invented a system of staining by which the bodies of the glia cells are coloured yellow, while the glia fibres and the nuclei of the nerve-cells are coloured blue.

The neuroglia has generally been credited with the simple function of giving support to the nervous structures and their capillary vessels; but Ramón y Cajal [51] has recently attributed to it a more ambitious design. He considers that the glia-cells may, by alternate contraction and expansion, either promote or impede the work actually done by the nerve-units, or neurones. He distinguishes three different kinds of glia-cells, viz. :—

1st. Those of the *white matter*, which are intended to form a badly-conducting substance between the nerve-fibres, so as to prevent a diffusion of nerve-currents.

2nd. The *perivascular* glia-cells, which occur only in the neighbourhood of the capillaries of the grey matter, to which they send processes or pseudopodia, which are inserted at the external surface of the endothelium, and which serve for producing local dilatation or congestion of the blood-vessels, in accordance with the greater or lesser intensity of the intellectual operations ; and, finally,

3rd. The glia-cells of the *grey matter*, which have a most variable shape, being sometimes stellated, and at other times drawn out like a comet. They are furnished with exceedingly numerous collaterals, or pseudopodia, which impart to the whole arrangement the form of a winged star. Ramón believes these cells to be in a state of contraction during intellectual activity, when, according to him, the body of the cell appears enlarged, its processes shorter and thicker, and the secondary processes reduced to vanishing point; while during the period of rest the cell would appear relaxed, its processes elongated, and their terminal branchlets plainly visible.

The great Spanish anatomist further contends that, when the cell and its processes are relaxed, the latter act as insulators, and push themselves between the nerve-cells and their dendrites, thus impeding or preventing the passage and conduction of nerve-currents. Such a state would account for the phenomena of mental repose and sleep, whether natural or artificial, such as induced by narcotics and hypnotism. On the other hand, contraction of the glia-cells and shortening of their pseudopodia, would lead to contact between the previously separated nerve-cells and their branches, thus causing the brain to become active. Such contractions of the glia-cells would, according to him, occur either automatically, or through the stimulus of volition, which would thus direct the process of association in different ways.

Ramón's hypothesis would, if adopted, easily account for most intellectual phenomena, whether normal or morbid. Thus we need only assume the glia-cells to be contracted in some places and relaxed in others, to be able to understand why there should be in certain cases excitement in thoughts and words, hesitating speech, fears and pains, and loss of memory for words, names, thoughts, etc.

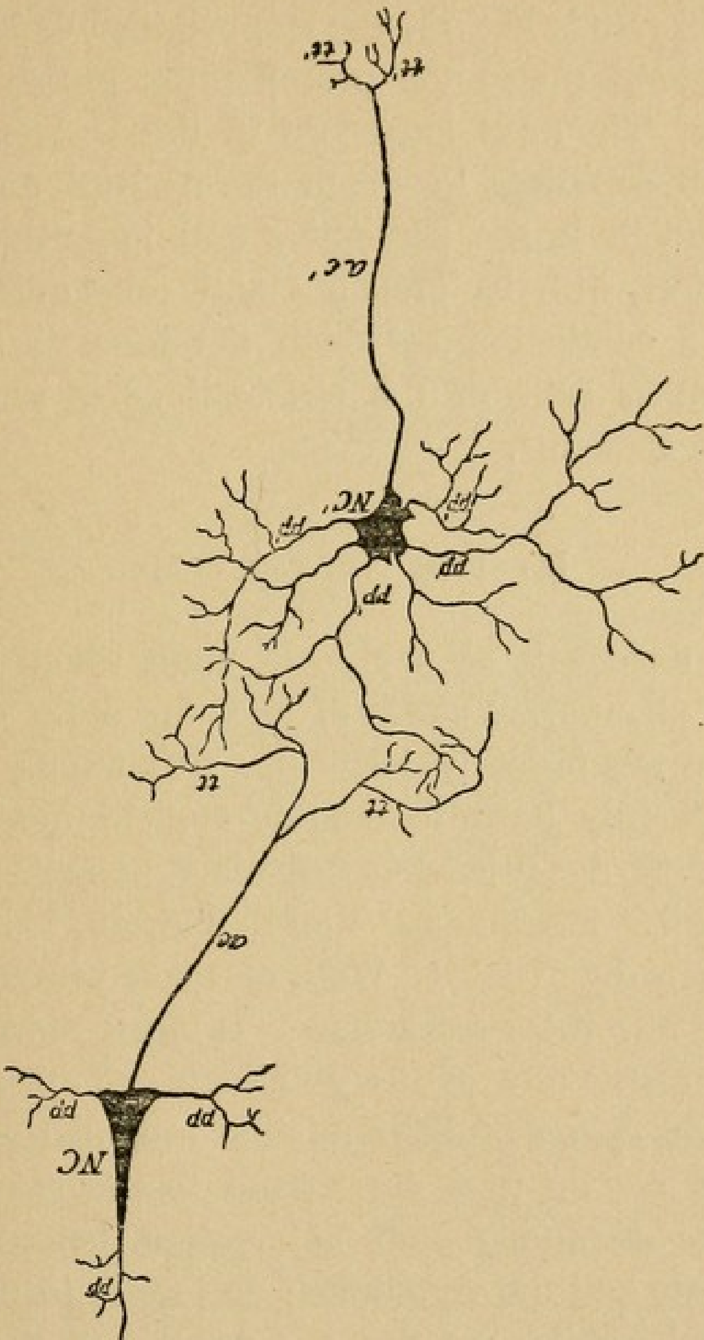
A second factor in producing mental phenomena would be, according to Ramón, an active hyperæmia of the capillaries of the excited area, leading to increase of temperature and metabolism in the brain. This would be effected by contraction of the pseudopodia of the perivascular glia-cells taking place under the influence of volition, and thus producing dilatation of the blood vessels.

Ramón's argument shows that a man may be a great anatomist, and yet not a great philosopher. A destructive criticism of his theory has been given by Kölliker,[15] who has shown that Ramón has failed to bring forward any proofs for the contractility of the glia-cells; and that the different shapes in which these are unquestionably met with, can be otherwise and more simply explained, partly by original formation, and partly by the circumstance that, when using Golgi's method, the glia-cells as well as the nerve-cells are habitually stained to a variable extent. Nor has Ramón shown that the glia-cells are insulators, such as the myeline-sheaths of the axones. Moreover, if volition were required for effecting contraction of the glia-cells, we must for this very purpose invoke the aid of the nervous units themselves, which would thus be shown to be the principal factors in mental operations, and thereby render an influence of the glia-cells unnecessary. If the glia-cells could contract and expand independently of the neurones, our whole mental and nervous activity would be determined by a factor which altogether eludes our control, and would render us the slaves of Golgi's cells. Yet nobody doubts that we are able, either to restrain any tendency to sleep we may feel, or to yield to it; that we may fix our attention on one or the other of our sensorial organs, or send it in a different direction; that we may revive certain trains of thoughts or memory, or cause them to disappear at will—all reasons for rejecting the influence of elements which are extraneous to nervous structures. The true function of the neuroglia must therefore remain as it was before—viz., to support and shelter the nerve-cells and their adnexa, and to fill up the empty spaces left between the individual nervous units.

Neurônes.

The substance of the brain consists of millions of nervous units, or "neurônes" (Waldeyer[52]), or "neurodendrons" or "neurodendridions" (Kölliker[15]), or "individuals" (Edinger[53]), which are connected with each other simply by contact, and which constantly act and react upon each other. This fundamental doctrine, which has simplified in an almost incredible manner our notions on the structure and functions of the nervous system, whether central or peripheral, has been slowly prepared and developed by the researches of such men as Golgi,[36] Cajal,[38] His,[54] Kölliker,[15] Von Lenhossék,[39] Gehuchten,[55] and many others; but has been actually laid down and rendered acceptable by Waldeyer[52] in his essay "On Recent Progress in the Anatomy of the Nervous Centres" (1891). It was necessary that such a new doctrine should be represented by a new and characteristic Greek term (*νευρών*); and, in spite of Kölliker's objections to it, this expression has, through its simplicity and pregnancy, at once gained civic rights in anatomy and physiology, as well as in clinical medicine. I remember the time when the term "telegraphic despatch" became too cumbersome, life being considered too short for it, and the word "telegram" was suddenly hoisted. The new word excited much anger and opposition in such centres of learning as Oxford and Cambridge; and a professor of Greek, while expressing his horror of etymology of this kind, advised the community to accept the term "telegraphema," as far

FIG. I.



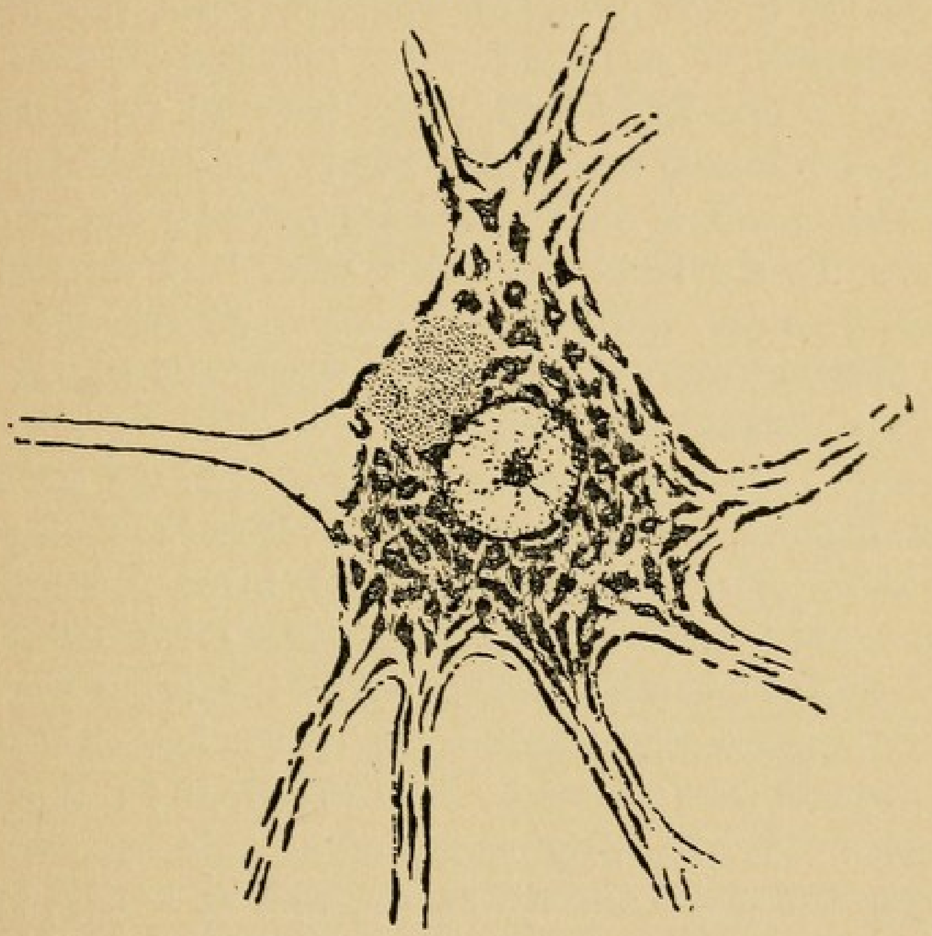
more correct and scientific. "Telegram," however, had already gained the day, and has retained its position ever since; while *telegraphema*, like *neurodendridion*, has remained stillborn. The objections of Schäfer[56] to Waldeyer's doctrine, viz., that the neurône is nothing but a modified nerve-cell, and should, therefore, be known, as heretofore, by the term "cell,' are invalid for various reasons.

The neurône consists, then, essentially of three parts, viz., the nerve-cells (N.C., Fig. 1); the axis-cylinder, or axône (A.C.), and its collaterals: and the protoplasmic processes or dendrites (P.P.). The most important of these parts is the cell itself, with its dendrites, in which the nervous force is generated, and which is the perceptive and impulsive element; while the axône, with its branches and collaterals, only plays the part of a conductor, by which the force is transmitted, whether to other cells, or the terminations of sensory areas, or contractile elements.

I.—The Nerve-Cell.

The grey nerve-cell, or neurocyte, upon which all nervous and mental phenomena depend, is a far more complicated structure than was formerly believed. Its anatomy has indeed only quite recently been thoroughly studied, more especially by Kölliker,[15] Berdez,[57] Schäfer,[58] Rosin,[59] Berkeley,[60] Ramón y Cajal,[61] Dogiell,[62] Flemming,[63] Von Lenhossék,[39] Hodge,[65] and more especially by Nissl.[66] Want of space prevents me from fully entering into these researches. It must therefore suffice to say that the structure of the ganglionic cell appears to vary according to its degree of differentiation and function, inasmuch as cells of a certain type correspond to the position of the animal in the ascending scale of creation, being different in the invertebrate and the vertebrate; and again in the latter, in the fishes and reptiles on the one hand, and the birds and mammalia on the other. The structure of the cell becomes constantly more complex as we proceed higher up in the scale of living beings; and its histological structure would appear to be an expression of the different physiological activities with which the cells are endowed. They must, therefore, vary greatly according to the function of the centre from which the cell is taken. The "nerve-cell" would thus appear to be a collective term comprehending many forms of cells, which are morphologically different from one another. Nissl has

FIG. 2.



indeed distinguished eight separate types which differ in internal structure, and may be looked upon as an expression of different cellular functions.

Nissl Bodies.

In the protoplasma of the nerve-cells there are found stainable parts, which are of importance for the physiological work of the cell. By employing various basic aniline dyes, more especially methylen-blue, the body of the cell, as well as its nucleus, has, as it were, been dissected into several sharply defined structures, viz., one which is deeply stained (the chromophile substance), another which is slightly stained, and a third which is not stained at all. That portion of the cell which takes staining is shown to contain *granula*, a large number of differently-shaped bodies, such as granules, clods, spindles, etc. The nucleus of the cell also contains differentiated substances, viz., a stainable external layer, which is called the wall of the nucleus, a relatively scanty framework, and accumulations of framework matter, in which there are generally one or several nucleoli. In the latter there is a small dark external zone different from the central chief substance. Between the meshes of the nuclear framework there is an apparently homogeneous and unstainable nuclear juice.

According as this staining is chiefly seen in the nucleus, or the granulations, or the body of the cell, Nissl has distinguished three different types, called by him karyo-chromes, cyto-chromes, and somato-chromes. The latter are by far the most numerous, and comprise amongst others the type of the motor or spinal anterior cornual-cell, which even at first sight appears to be different from all other cell-structures, and that throughout the whole ascending series of animals. Experimental pathology has shown that if a poison, such as arsenic, lead, or phosphorus, act on a cell, or when it is injured by over-exertion, or separated from its axone or proximate nerve-centres, there will be striking and typical changes in the cells which are connected with those structures, viz., a swelling of the body of the cell, and granular disintegration of the stainable parts, which lose their sharp outline, and to a great extent their property of becoming stained. Such changes may be recognised shortly after the injury has taken place, and are always accompanied or followed by proliferation of the glia-cells. The stained substance may indeed entirely disappear, and yet integral restitution may take place as long as the nucleus of the cell remains intact. These changes are so constant that even twenty-four hours after dividing the connection between a nerve-cell and a muscle, a change in the motor nerve-cell is already perceptible, and the further changes which will occur can then be predicted with certainty. Faradisation of certain cells has shown that the latter receive more colouring matter after, than before, such stimulation; and cells which had previously appeared pale were, under the influence of the faradic current, seen to become deeply stained.

The granula of the cell is, therefore, seen to be a carrier of potential, which by the activity of the cell is changed into kinetic energy. When the cell is forced to do increased work by morbid stimuli, its disposable potential energy is used up, and the deficiency of this leads to wasting of the granula, if there is no time or opportunity to form new reservoirs for energy. All deleterious influences acting on the cell are shown first in a change of the stained substance. Hodge[65] has shown that after fatigue—for instance, in bees after a long day's work—the stained granules appear to be diminished; the whole cell is of a lighter colour, and vacuoles are formed in it. The nucleus is seen to shrink after fatigue, to become angular, and to assume a darker colour than that of a nucleus which has had a thorough rest. Again, according to Held,[67] Nissl bodies do not exist in fresh cells, but may be precipitated by certain means, and the variable quantity of these bodies in different cells appears to be proportionate to the metabolism in them. They disappear in the protoplasma when the activity of the cells is altered by division of their axones, and after injurious influences, such as poisoning, fatigue, disease, etc.

Most observers are now agreed that nerve-cells are, from the very beginning and throughout the further course of their lives, distinct and independent individuals, which have no other communication with each other than by contact, and do not anastomose. This contact is effected by a most intimate interlacement of dendrites, which intertwine with those of other neighbouring cells in the most astonishing and abundant manner. Only Dogiell[62] appears to be of a different opinion. He assumes that nerve-cells of the same type form regular colonies, the individuals of which are closely connected with one another by an actual exchange of their protoplasma. He has described so-called "cellular bridges" in the ganglionic layers, and considers that the dendrites of the cells form a genuine network with large and wide meshes, within which the terminal branches of the cells anastomose by numberless fibres proceeding from one cell to another. These views, however, are repudiated by the best observers, and cannot, therefore, be admitted. Hammarberg,[68] who has made exceedingly elaborate researches into the morphology of normal nerve-cells, has also examined their appearance, size, number, and shape in a number of cases of imbeciles and feeble-minded persons, and found in all of them deficiency in the number of cells, as well as wasting of their substance. He has in a number of plates given a most interesting representation of the differences which exist in the nerve-cells of the brain of the insane and in normal brains, and thus laid a definite base for the study of the pathology of mental diseases. Similar investigations have been made by Lockhart Clarke,[69] Obersteiner,[70] and Bevan Lewis.[71]

Different Kinds of Nerve-Cells.

The size of these cells varies very much, some being so small that they can only be distinguished with the microscope, while others are so large that they may be easily seen with the naked eye. Their number is in general proportionate to the number of muscular, glandular, and sympathetic elements on which they have an influence, and on the extent of the epithelial surfaces from which they receive currents through the instrumentality of sentient and sensory nerves.

The arrangement of the cells of the cortex of the brain has only recently been thoroughly studied with the aid of Golgi's method, and Meynert's description of them, which was in former years looked upon as classical, no longer holds good. There are two types of cortical nerve cells, viz., *Golgi's first type*, in which the axone remains single; and those of *Golgi's second type*, in which the axone is, after a short course, dissolved into numerous fine ramifications or collaterals. The principal cells of the first type are the so-called *pyramidal cells* (N.C. Fig. 1), which are truly characteristic for the cortex, and appear, in perpendicular sections, triangular in form, the base being turned towards the white matter, and the point upwards. These cells are small in the external layers of the cortex, but generally become larger as they proceed inwards, and eventually turn into "giant-pyramids" (Betz). The frontal convolutions contain chiefly large and medium-sized pyramids; giant pyramids only occur in a small area round the central convolutions; and small pyramids occur in very large numbers in the occipital lobes. We habitually meet with *four* different kinds of layers in the cortex, of which the first represents a superficial layer, the *stratum zonale* (Kölliker), containing chiefly glia-cells and elements of a doubtful kind; the second is the external grey layer, consisting of small pyramidal cells; the third is the internal white layer, with medium-sized and large pyramidal cells; while the fourth, or internal grey layer, consists of polymorphous cells, which are smaller and somewhat irregular, some of them resembling the pyramidal cells, while others are simple multipolar cells of different shapes. In several convolutions, however, the cortex appears, according to the elaborate researches of Hammarberg[68], to consist of *six* layers of cells, viz., 1st, the stratum zonale; 2nd, the first layer of small pyramids; 3rd, the first layer of medium-sized and large pyramids; 4th, the second layer of small pyramids; 5th, the second layer of medium-sized and large pyramids; and 6th, the polymorphous cells. Dendrites are numerous, there being one very long process advancing from the point of the pyramid towards the stratum zonale, where it splits up into extremely numerous fine horizontal fibrils. Numerous other dendrites proceed from the base and the sides of the pyramid. The axone originates from the centre of the base, and proceeds, either in a straight or slightly curved line, through the deeper layers of the cortex into the white matter, giving off fine "collaterals" in its course through the cortex, which have, when fully developed, a myeline sheath, so that every pyramidal cell is connected not only with a single, but with several or many true nerve-fibres. The length of the pyramidal cells varies from 6μ to 80μ; "giant pyramids" being those which are from 35μ to 80μ long, while their width varies from 4 to 50μ, giant pyramids being from 30 to 50μ wide.

Cells of *Golgi's second type* are those whose axones have only a short independent course. They do not proceed beyond the cortex, but divide, within the grey matter, into astonishingly numerous bundles of branchlets. They are chiefly met with in the cortex of the cerebellum, but occur also in the cornu ammonis, the fascia dentata, the olfactory bulb, and some other parts.

Golgi's theory that the cells of his first type are motor, and those of his second type sensory in nature, has not been accepted by histologists. It is more probable that, owing to their short and abundantly ramified processes, the cells of the second type are intended to act on structures in their immediate neighbourhood, that is, to connect, for functional purposes, cells which are lying close to each other. They may therefore be described as *association cells* (Schäfer's intermediary cells).

It is generally acknowledged that of all the different parts of the neurone, that portion which contains the *nucleus of the cell*, is the most important; for the nucleus has a paramount influence upon the formation, metabolism, growth and multiplication of the cell; and in uni-cellular organisms on its very existence. Yet opinions differ on the point whether all brain-cells have the same function, or whether separate functions are inherent to the different structural types of cells. Thus Cajal,[16] lays stress, not only on the number of nerve-cells of the cortex, but distinguishes sentient, sensory, central, psychomotor, and association cells : while Kölliker,[15] is inclined to assume that all nerve-cells have essentially the same function, and that their different performances depend more upon differences in their environments, in the external stimuli which act upon them, and in the possibilities of response to such stimuli. Thus he considers that a cell which is only in contact with muscular mechanisms will be unable to act in an olfactory sense, etc. To him, therefore, every single cell appears potentially to possess the faculty of carrying out all performances which are required of the nervous system and the organs subservient to it, whether motor, sensory, or mental.

Support for this view is given by comparative anatomy, showing that in certain cases a very small number of cells can do what is in other cases only done by a plurality of them. Thus the electric organ of Malapterurus is ruled by a single giant cell; amphioxus and other fishes contain similar giant cells in the cord, from which enormous motor fibres originate. At the same time there can be no question that there are three different types of cells according to function, viz., 1st, the motor cell in the anterior cornua of the spinal cord, the motor nuclei of the bulb, and Purkinje's cells in the cerebellum; 2nd, the sensory cells in the ganglia of the cranial and spinal nerves, the olfactory cells of the Schneiderian membrane, certain retinal cells, and cells of the terminal sensory nuclei in the cord and brain; and 3rd, the pyramidal cells of the cortex, to which the intellectual phenomena appear to be bound. The predominance of one or the other set of these cells, would therefore be connected with the scale of animals as far as intellectual, sensory, and motor functions are concerned; and this would likewise apply to different individuals of the same species. Thus we know that animals which have a very large size, and therefore a bulky brain, are not for that reason always the most intelligent of their kind, as the grey matter may in them be chiefly composed of psychomotor cells, and such as receive sentient and sensory currents, which would leave only a comparatively small space of the cortex for the association cells, which form the anatomical base of the intellectual activities of the brain. In the same way one human brain may be of equal size and bulk with another, and yet the intellect of the two persons concerned may be very different; and a brain of moderate, or even less than average size, may be capable of high intellectual activity, provided it contains a larger number of association cells in proportion to motor and sensory ones.

From these considerations it naturally follows that the *mere weight* of the brain, upon which so much stress was formerly laid, is really of very little importance. The average weight of the male European brain is from 1,300 to 1,450 grammes, and of the female brain somewhat less. It has, however, often happened that unusually heavy brains have been found in persons who had been very insignificant during life, while in highly intellectual men the weight of the brain was somewhat under the average. A great painter, or sculptor, or musician, or scientist, or lawyer, or doctor may have certain territories in his cortex highly developed, without a correspondingly large amount of nerve-matter in other areas. His entire brain may, therefore, possibly weigh less than that of a butcher or prize-fighter, whose psychomotor area may be exceedingly heavy. Gambetta's brain, which showed an amazing development of Broca's convolution, was altogether lighter than that of other persons whose names have never been heard of in history.

With regard to this point Perls has made the interesting observation that in a considerable number of great men a hydrocephalus would appear to have existed in infancy, and to have disappeared later in life. He concluded from this that in a skull which had become dilated, the eventual growth of the brain would meet with less resistance than in an ordinary healthy skull. It is well known that Cuvier and Rubinstein had in infancy suffered from hydrocephalus, and the brains of both of these great men were found after death to be unusually heavy. A moderate degree of hydrocephalus in infancy would, therefore, appear to be a rather desirable possession.

II.—The Axone.

The next constituent of the neurône is the *axis-cylinder*, or principal nerve-fibre (Fig. 1, *a*, *e*), or nervous process, or neurite (Rauber), or *axône*, or neur-axone (Kölliker), which may be motor, sentient, sensory, or sympathetic, and which constitutes in almost all cases a single long nerve-fibre proceeding from the cell, and which, after passing on for some distance, terminates in a network of very fine branches, or terminal trees (Fig. 1, *t*, *t*) or *collaterals*, all of which have a free end, and do not anastomose with others. Only in one place, viz., the most superficial layer of the cortex, Cajal has discovered a peculiar kind of cells, from which *several* fine nervous processes arise, which he has called *poly-axones*. Cells with a single nerve-process are termed *mon-axones*. Poly-axones had already been seen and described by Retzius,[72] who, however, felt doubtful about their nature, but has recently[73] accepted Cajal's view concerning them. In the peripheral nerves, on the other hand, such as the cerebro-spinal ganglia, a different system prevails, for these cells are in all vertebrates bi-polar, and therefore called *di-axones*, being furnished with two processes, one of which travels towards the centre, and the other towards the periphery. The sympathetic ganglia of the ganglionated cord are again different and resemble the central ones, having only one nerve-process; while the peripheral sympathetic ganglia, such as those of the intestines, are poly-axones. Cells without any nervous processes—*anaxones*—are only found in a single place, viz., in the granular layer of the olfactory bulb (Golgi, Cajal).

The principal feature of the axone, which distinguishes it from the protoplasmic processes, is that it originates in a small cone formed by the corresponding portion of the cell, from the body of which it is sharply set off; or it may arise from a small dendrite near the body of the cell. It has an equable calibre, is smooth and regular, and looks like a thread of black cotton on a white ground. While the dendrites form as it were a unity with the cell, the axones are products of the latter, and, therefore, more independent. They differ in width and length according to the longer or shorter course they have to pursue; those, for instance, which proceed from the anterior cornua of the cord to the muscles of a remote region, being uncommonly long and proportionately stout.

While Deiters[74] had described the axone as an altogether simple formation, which never divided into branchlets, Golgi[35] has shown that in a large number of cells the axone gives off, very shortly after its origin, a number of very fine collaterals to the grey matter ("lateral fibrils"), while in its further course it sends forth a number of larger *collaterals*, or *paraxones*, or *paraneurites*, which proceed at right angles from the body of the fibre, and dissolve into complex terminal branches. In some instances the axone divides close to the cell into two branches, one of which is equivalent to the other. Such formations are called *rhizaxones*. This bifurcation of the axone is so common that the number of nerve-fibres of the white matter of the brain considerably exceeds that of the nerve-cells of the grey matter. Such an arrangement is evidently intended to cause the influence of a single cell to be exerted on a larger area. In any case the axone has always a free end.

The differentiation of the axone increases proportionately to the higher position of the animal in the ascending scale of creation, being plainly perceptible in a primordial form in the invertebrates, and more developed in the fishes and reptiles, while a full net-work is only seen in the highest vertebrates. Large monopolar cells with a single axone, however, occur also in man, and have recently been described by Golgi as occurring near the Sylvian aqueduct. These cells were formerly believed to be the origin of the descending root of the fifth nerve, but Golgi[75] has shown that their single axone proceeds to the fourth cranial nerve. The axone appears to be a soft but solid formation, consisting of fibres and a homogeneous intermediate substance, which Kölliker has termed *neuroplasma*, and Waldeyer *axoplasma*. Leydig and Nansen consider that the axone exists in a liquid condition.

All neurones of the cortex may be described as association-neurones, the axones of which may be of very different length, varying from one millimetre to 15 centimètres and more. Flechsig[25] has found association-neurones in the left auditory sphere, whose fibres proceeded to the occipital convolutions, to the insula, and as far as the upper and basal parts of Broca's convolution. It is to these association-neurones, being the chief carriers of mental operations, that man owes his mental superiority to animals.

While Golgi[75] and his pupils consider that there is a kind of general fine nervous net-work in all the different layers of the grey matter, which receives the expansions of the nerve-cells and sends forth sensory nerve-fibres, His[54] was the first to lay stress upon the independence of the central nerve-cells from each other, and the free termination of sensory fibres in the white matter, which he had observed in his researches on the development of the fœtus. It was, however, Ramón di Cajal[61] who succeeded in showing that this also obtains in the nervous centres of completely developed animals. It appears then that, where Golgi had supposed the existence of a network, the terminations of the axones are in reality free. Thus the difference between the two types of Golgi's cells, which was at one time believed to be fundamental, has considerably lost in importance, inasmuch as it amounts simply to the one set having a long, and the other a short axone. Lenhossék[39] has called the typical long process *inaxone* (from ἰς, fibre), and the short one, which almost immediately becomes split up, the *dendraxone*. The bearing of this difference is even further reduced by the circumstance that there are intermediary forms between the two, where it is actually difficult to decide to which type an individual cell may belong. There is, therefore, no net-work, but a dense conglomeration, the numerous constituents of which are abundantly crossed and interlaced, but nevertheless entirely independent of each other, and never anastomose. This conglomerate has been termed *neuropilema* by His,[76] and may be compared to a primæval forest, the impenetrable thicket of which consists of densely intertwined, yet essentially separate individual trees and branches. Thus the connexion of nervous elements is entirely one of intimate contact, which is as efficient in a physiological sense as actual continuity of matter would be. The termination of the nerve is marked by a special thickening or clump, the *cône d'accroissement* of Cajal; and wherever a fibre is seen to end with such a clump, this may be taken as its definite termination. Intimate contact rather than actual continuity, has long been known to be the mode of action of the terminations of the motor nerves in the muscles. The new theory, that the path of conduction is everywhere formed by a number of nerve-units or neurones, which, like the links of a chain, only join one another by free contact, and are yet independent in a certain sense, renders all our ideas of the actual way in which the work of the nervous system is accomplished much more simple and easily intelligible. Waves of energy do not pass in continuity, but cease in their original form at the terminal trees of the first neurone, whence they proceed to act by induction, leading to a certain change in the second neurone, which is in contact with the first, without the action being truly identical. Each unit or neurone is, therefore, able to alter the nerve-current in a way peculiar to itself, by induction, which appears to correspond much better to the complex character of nervous work than to assume an uninterrupted path, carrying an impression unchanged all the way from the beginning to the end.

How is the nutrition of the axone effected? It appears to be carried on in a two-fold way, viz., partly from the neighbourhood, and partly from a distance. The fibre certainly possesses, at a certain stage of development, numbers of blood-vessels, from which nutritive material must be drawn for the axone, and thrombosis or embolism of which are known to injure the function of the nerve-fibre. The principal trophic influence, however, is given to it by the nerve-cell from which it starts. Waller, sen.,[77] showed many years ago that when the axone has been separated from its cell, degeneration takes place in the former, which begins at the place of injury, and eventually causes the whole of the separated fibre to perish—descending or celluli-fugal degeneration—and that whether the fibre be afferent or efferent, sentient or motor. Connection with the nerve-cells is, therefore, indispensable for the integrity of the nerve-fibre (*Waller's Law*). Goldscheider[78] has recently started the theory that there is a real transport of some substance into the axone and its most distant parts from the cell itself, and that this substance which he assumes to be a ferment, enables the fibre to assimilate the nutritive material which is absorbed by it from the neighbouring blood-vessels.

The trophic action of the nerve-cells on the axone does not appear to be exerted quite equally in all parts of the latter, but diminishes as the distance from the cell increases. Strümpell[79] has drawn attention to the fact that in toxic paralyses, such as arise from poisoning by lead, alcohol, the organic toxines, etc., peripheral neuritis is apt to appear in the parts which are at the greatest distance from the nutritive centre, that is, the anterior cornua of the cord; and that these cells themselves only appear to suffer in extreme cases. Again, in degeneration of the crossed pyramidal strands, owing to affection of the pyramidal cells of the cortex, the morbid process begins at the lower portion of the cord, and thence progresses further upwards, but is arrested in the bulb.

Conversely, the integrity of the cell itself is likewise dependent upon a normal condition of the axone, injury to which will damage the cell. Marinesco[80] has shown that in persons whose limbs have been amputated, the large cells of the anterior cornua corresponding to the removed parts begin to waste after a time, and eventually perish altogether. This degeneration may also affect the anterior roots and posterior columns, and peripheral injury of the motor nerves may thus lead to ascending degeneration of the central parts. This phenomenon occurs in direct contradiction to Waller's law, and probably escaped Waller's attention, because at his time the methods of examining the nervous structures were still in their infancy. With our present more refined modes of investigation Nissl[81] was enabled to ascertain that even a few days after division of the portio dura, its nuclear cells in the bulb will begin to degenerate, while the nucleus shows a tendency to approach the periphery of the cell too closely. The further course of things appears to depend upon the circumstance whether the peripheral nerve recovers or remains damaged. In the former case, which occurs habitually when only a small portion of nerve has been excised, the central cells will likewise recover, while, when a large piece of a nerve has been removed, and the axone is therefore permanently destroyed, the central cells will waste away altogether. A singular fact is, that the central end of the nerve is also found to waste under these circumstances, but much more slowly than the peripheral one; and this is no doubt owing to the slowly progressive destruction of the cell, which constitutes its trophic centre. Celluli-petal changes of this kind may possibly be due to the circumstance that, after the connection of the cell with its terminals has been interrupted, the usual physiological stimuli, whether voluntary or reflex, which also promote nutrition, do no longer act, so that the cell wastes through the loss of these latter.

The axones of the typical pyramidal cells proceed throughout in a centrifugal direction from the cortex into the white matter, and we have to distinguish four different sets of fibres, viz. :— first, *projection fibres*, which originate from the large pyramidal cells, and after giving off numerous collaterals, penetrate through the corona radiata into the central ganglia and the internal capsule; second, *commissural fibres*, which originate from the small and medium-sized cortical cells, and have no definite relations to the projection-fibres, but penetrate into the corpus callosum; third, *association fibres* which originate, like the commissural fibres, from the smaller cortical cells, and divide when entering the white matter, so that one cell may connect one, two, or several regions of the same hemisphere, or may, on the other hand, connect certain portions of both hemispheres with each other through the corpus callosum; and finally, fourth, *centripetal fibres*, which are seen everywhere, the larger coming from the corona radiata.

There is, however, no essential difference between centrifugal and centripetal fibres, except the direction of the axone, which is descending with the former and ascending with the latter. This explains why centrifugal fibres degenerate in the descending and the centripetal ones in the ascending direction.

For further information on this subject I would refer the reader to the splendid work of M. and Madame Dejérine,[82] who have not only traced the course of the fibres through dissociation, as was formerly done, but have stained entire human brains with hæmatoxyline according to Weigert's method, and then made consecutive sections through the same, which are represented in a series of plates, giving a wonderfully clear and accurate picture of the course of the central nerve-fibres in the brain.

Another excellent work of this kind is that of Brissaud,[83] in which a series of sections of the hemispheres, in different directions, is given in beautifully-executed heliogravures, showing the paths of association, with minute explanation of all the plates. Good German works of the same scope are those of Sachs,[84] Edinger,[85] and Flatau.

The Myeline Sheath.

The special function of the nerve-fibre in the vertebrates only begins when the axone is surrounded by a normally developed medullary or myeline sheath, and the latter is therefore indispensable for the functional activity of the nervous mechanism in those animals whose nerves carry myeline sheaths at all. Changes in, or atrophy of, the latter, lead to grave functional disturbances in the nervous system, and there is a direct proportion between the development of the brain and the progress of myelination.

I have already spoken of Flechsig's[25] researches on this subject (p. 20), and will, therefore, here only add that Ambronn[86] has quite recently given us a further efficient and convenient test for the progress of myelination, in the use of the polarised light. This test has the peculiar advantage that it does not, like the osmium and hæmatoxyline tests, alter the structure of the medullary sheath; and it shows that this structure, in its course of development, undergoes definite changes in colour. The non-myelinated fibres and the connective tissue are by this means shown to be of a violet, indigo, and blue colour; while, in proportion as the fibre becomes myelinated, the colour gradually changes to purple, red, pink, orange, yellow, and white. The thoroughly matured myeline sheath eventually appears as a brilliant yellowish white fibre. The peculiar colour of the myeline sheath, when fully matured, appears to be owing to the presence of lecithine, which is absent when the sheath appears bluish green, and gradually increases in quantity as the changes in colour, as above-mentioned, become established. Besides lecithine, which is the most important constituent of nervous matter, the sheath also contains protagone, cholesterine, and neuro-keratine.

The first nerves to mature are the motor nerves and certain central reflectory systems, such as the antero-lateral columns of the cord, and the bulb; while sentient nerves and sensory systems, such as the posterior roots and columns of the cord, the sentient nerves and their secondary intra-cerebral paths, are still immature. An exception is, however, formed by the vestibular nerve, which matures as early as the motor nerves, and is fully developed when the optic nerve is still quite naked.

What is the object of the myeline sheath? It is, apparently, intended to serve as an insulator, so that electric currents may be conducted along the axone without diffusion. The resistance to passage is five times greater in the transverse section of the myelinated nerve fibre than in its longitudinal section, so that the nerve-current will naturally take the easiest way, and run along the longitudinal section. Myelinated fibres can, therefore, not act upon each other, or upon nerve-cells, and they are likewise unable either to receive impulses from unmyelinated fibres and dendrites, or to respond to them. The typical way of conduction of cell-power is, therefore, through the axone, which is in intimate connection with the cellular protoplasma; and thence the stimulation is transmitted by all myelinated axones, without there being the possibility of transmission to neighbouring parts of the nervous system. Transmission is only possible where the myeline sheath disappears, and the axones become free, naked, and uninsulated.

In the *peripheral terminations* of the sensory organs, matters are so arranged that the terminal ramifications of the axones are naked—*i.e.*, devoid of myeline. Being thus unprotected, they are enabled to receive impressions from external stimuli. In order, however, that the propagation of such stimuli may take place in an orderly manner, the fibres are in their further course insulated against external influences; and this condition is only fully attained when the myeline sheath has become matured.

The *central terminations* of the sensorial organs are arranged on a similar plan. There also it is necessary that the last terminations of the axones should be devoid of myeline, and therefore able to transmit the stimulation, which has up to that time been insulated, to the dendrites of the cortical cells, and the second intra-cerebral conducting path originating from these cells.

The terminal ramifications of the *motor* nerves in the muscles are likewise devoid of myeline, so that the transmission of stimuli from these nerves to the muscular fibres cannot be interfered with by an insulating layer.

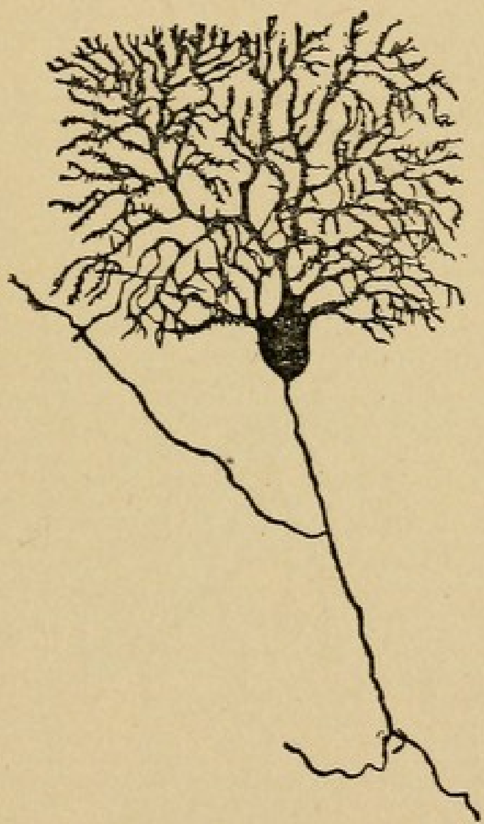
How do the non-myelinated collaterals of the axones conduct? In general, it has been assumed that they act celluli-fugally only; but Von Lenhossék[39] has recently asserted that all collaterals which proceed from the beginnings of the axones act like dendrites, and conduct celluli-petally, while those which originate at a greater distance act celluli-fugally. The former he calls *axodendrites*, and the latter *paraxones*.

III.—Dendrites.

The third and last constituent of the neurone is formed by the *protoplasmic processes* (Deiters[74]) or *dendrites* (His[76]) (*p.p.*, *PP.* Fig. 1). These arise from the internal margin and the sides of the cell, and divide, almost immediately after leaving it, into a number of different branches. These latter terminate with a free end between the dendrites, or the neighbouring cells.

The dendrites are broad and stout, and become gradually attenuated by division, like the antlers of a stag. Their course and distribution is irregular, their appearance knotty, showing numerous varicosities up to their terminal ramification. These varicosities were at one time believed to be artificial productions, but such is not the case, although with Golgi's method they appear more striking than with other procedures. The dendrites always have a free end, which is either pointed or furnished with a terminal knot. There are no connections either between the branches of the same cell, or those of neighbouring cells, which is clearly apparent on examining places where only few cells have taken the stain in the same neighbourhood, and where, therefore, no (or only few)

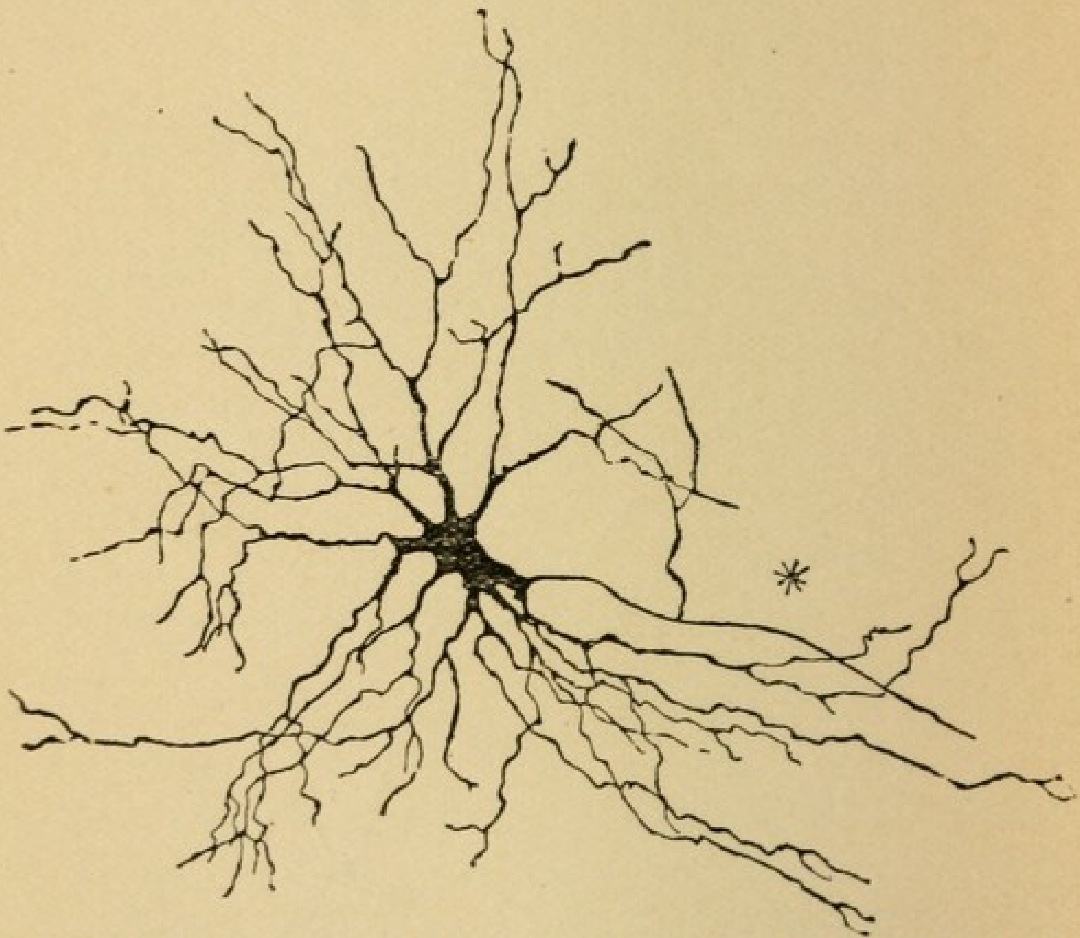
FIG. 3.



A Purkinje's Cell from the cerebellar cortex of a kitten, 15 days old, with numerous dendrites arising from the upper portion of the cell (after Cajal).

crossings and overlapping of dendrites are to be found. This is alsoshown on examining dendrites in their first period of development, *e.g.*, in very young fœtuses of chickens, in which the tenderest threads and minimal knobs and prongs become conspicuous on the cells. There is an infinite variety in the ways in which the dendrites originate from the cell, and become further ramified ; and the various aspects of the nerve-cells are quite as much owing to this as to the differences in the shape of the body of the cell itself, which sometimes appears actually insignificant compared with the dendrites. The luxuriant development of these processes is apt to create astonishment mingled with reverence at

FIG. 4.



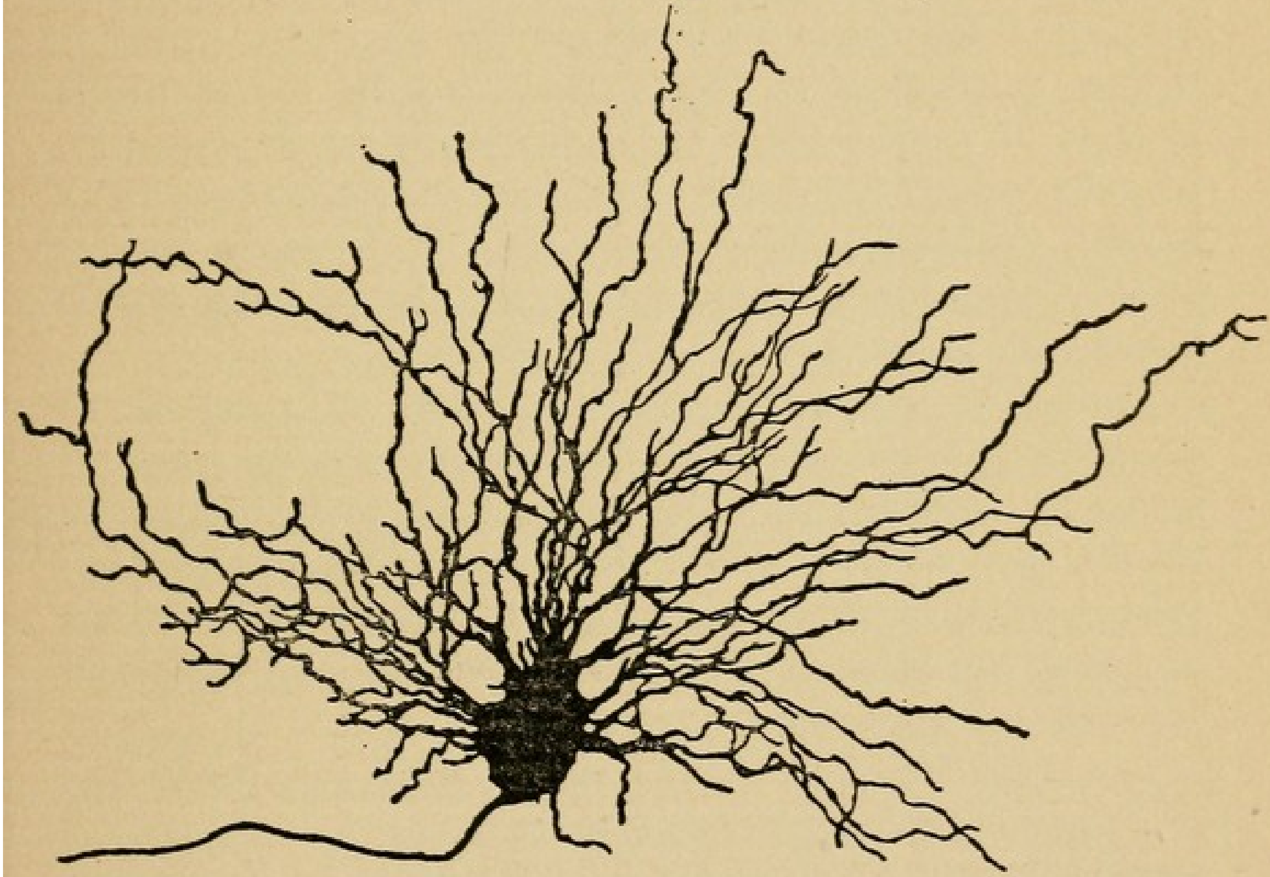
Motor Anterior Cornual Cell from the cord of a human fœtus, 30 cm. long.

the bountiful way which is employed by Nature in her work. The conglomerate of dendrites has been called *Neurospongium* by Waldeyer.

The differences in the dendrites are well seen by comparing a Purkinje's cell from the cerebellar cortex (Fig. 3, p. 47) with a motor cell from the anterior cornua of the spinal cord

(Fig. 2, p. 29), a cell from the nucleus dentatus cerebelli (Fig. 5), and a pyramidal cell from the cortex of the central convolutions (Fig. 1, p. 27). Thus in the cerebellar cells the dendrites originate only from one side of the body of the cell, and show a luxuriant development, while in the anterior cornual cell they originate all the way round from the cell-body, and are plentiful everywhere. In the pyramidal cell of the cerebral

FIG. 5.



Nerve-cell from the nucleus dentatus cerebelli taken from a human fœtus, 34 cm. in length.

cortex, on the other hand, their number is limited, for the chief dendrite rises from the point of the cell, is straight, stout, and simple, and only divides into a few branches at the upper part.

The dendrites being of the same substance as the protoplasma of the cell, may be taken as having the same fundamental properties as the latter: and as their surface is enormously extended, they may be assumed to have an even

E

higher susceptibility to nervous stimuli than the cell itself. In contrast to the axone they act celluli-petally, and it is clear that the nervous functions can take place more easily in the enormously subdivided protoplasmic processes than in the cell itself. Otherwise it would be difficult to conceive why the dendrites should be so extremely plentiful as they are found to be.

Apart from their purely nervous function the dendrites are concerned in the nutrition of the nerve-cell. Fresh lymph is always absorbed by the surface of the cell, while effete matter is excreted, likewise in the liquid condition.

This metabolism is greatly facilitated by the enormous increase of surface which the cell obtains by its dendrites. Schiefferdecker[87] has drawn attention to the circumstance that in many instances a real cellular surface hardly exists, but has actually merged into its dendrites, so that the absorbing surface belongs almost exclusively to these processes.

Absorption appears to take place from all parts of the dendrites, and not only from their points, as Golgi has been inclined to assume; and this has nothing to do with blood-vessels, for it occurs at a time when no blood-vessels have been formed, nutritive material being drawn from the lymph which permeates the whole of the nervous structures, and fills up all gaps left between them.

In a physiological sense the dendrites differ from the axones by conducting celluli-petally, while we have seen the axones to conduct in general celluli-fugally. Dendrites do not exist in the invertebrate animals, are scanty in fishes and reptiles, and become more fully developed, both as far as number and length are concerned, in the birds and mammalia. They are thus seen to have an important function, allowing of more abundant inter-cellular associations, so that eventually a single sensation may lead to a co-ordinated action of a large number of motor nerve-cells. It is likewise a significant fact that the dendrites, as well as the collaterals, become gradually more ramified, more extensive, and more complicated in the human species as the fœtus develops, and during the first few years of extra-uterine life. Their growth, therefore, seems to be promoted in the same ratio as mental activity advances, and the system of association between the different cells of the brain becomes more fully developed. Mosso has shown that the act of fixing the attention on certain facts and ideas is connected with a physiological hyperæmia of certain areas of the brain; and it may be assumed that, when this is frequently repeated, the bulk of the protoplasma of the cell will be gradually increased, the dendrites will extend further, and new ones may spring up, at a time when the nerve-cell has already lost its faculty of multiplication.

While, therefore, the dendrites carry on an important part in the work of the neurone, they can of course accomplish this only when their arrangement and situation are of such a kind as to allow stimuli to act upon them. In many places, however, the anatomical conditions for such stimulations are not present; and the action of the dendrites is then limited to their influence upon metabolism, and the nutrition of the cell and its axone.

The plasticity of the protoplasmic processes varies according to age; it is greatest in youth, diminishes in the adult, and disappears almost entirely in the aged. This explains why there may be such sudden changes of opinion in young people when they are suddenly withdrawn from the influence of parents and guardians, while such changes are rare in middle life or old age. The objection to new things and ideas, which is so prevalent in old age, may also thus be accounted for.

Whether there is a special chemical compound to which consciousness is bound, is not known; it is, however, certain that consciousness cannot continue, even for a second, if the supply of arterial blood to the brain is interrupted; and we must therefore conclude that a continuous oxidation of the ganglionic cells is necessary for consciousness. It seems, however, certain that the presence of lecithine is inseparably bound up with the matured condition of the neurone.

The principal anatomical factors of the activity of the brain are therefore the nerve-cell, the axone and the dendrites; while its work is likewise influenced and modified by the degree in which the blood-vessels of the brain are filled, by the quality of the nutritive fluid, the width of the peri-vascular lymphatic spaces of the grey matter, and the state of vasomotor excitability, by means of which the quantity of blood, which under the influence of volition and attention is thrown into the several portions of the brain, may be altered.

The normal and intellectual peculiarity of every man depends therefore upon the combination of the anatomical and physiological conditions noted above. If one or any of them are diminished, destroyed, increased or perverted, certain moral, emotional, and intellectual anomalies will be the result. The science of the future may thus perhaps succeed in tracing diseases of the mind to atrophy of nerve-collaterals and protoplasmic processes in certain areas of the brain; and imbecility or deficiency of intellect may be shown to be owing to arrested growth of dendrites, or in other words, to a continuance of the fœtal condition of the association cells.

In spite of all these results of modern scientific research, we appear to be as far as ever removed from a comprehension of the mode in which nerve-cells respond to the action of external stimuli, or act when movements are carried out, or sensations perceived, or mental operations connected with thinking and volition are performed. Indeed, we seem in this respect still to be very nearly on that low level which was so cleverly described by Stenson,[18] more than two hundred years ago (p. 13). A hypothesis recently proposed by Rabl-Rückhard,[88] on this point, has therefore attracted considerable attention. This author starts with the assumption that the conglomerate of the finest nervous fibrils in which the dendrites terminate, (neurospongium, Waldeyer), is bound to play an important part in the processes of all higher nervous functions. It is evidently there that the exchange of the different molecular processes takes place, the focus of which is in the cells themselves. Each pyramidal cell of the hemispheres must be looked upon as the carrier of a definite number and kind of perceptions and recollective images, the sum total of which is called memory. All our highest mental action would be only the constantly varying combination of the single perceptions accumulated in the molecules of the cells, or, at least bound to them as to its material base. He further argues that this fine network is not anything unchangeable, rigid or fixed, but has, during life, a vigorous mobility and constant change of communications ; in other words, the dendrites are subject to the *amœboid changes*. When we are thinking, the fine ramifications of the dendrites may be supposed to be in ceaseless motion, to stretch themselves to enter into a temporary connection with others, and to become separated again at other spots. Thus a kind of mechanism of mental actions might be conceived. A thread of thought which is cast away may, in this way, be equivalent to a torn-off dendrite of a memory cell ; an ingenious combination analogous to a temporary connection of different ganglionic cells, the dendrites of which are endowed with particularly vigorous amœboid motions ; while intellectual languor would be owing to a slow play of the same processes. Sleep, dreams, hypnotism, etc., might thus be assumed to be only phenomena of partial palsies of the dendrites of certain ganglionic cells.

However ingenious and attractive this theory may appear, it suffers from the incurable fault of being utterly unsupported by facts. This is also the case with the modifications of Rabl-Rückhard's hypothesis, which have been started by Tanzi,[89] and Lugaro.[90] They consider that slower movements and motions of growth occur in the ends of the neurones during mental activity. Now there can be no doubt that the neurones are slowly developing and growing during the first few years of extra-uterine life, and probably at a later period, in proportion to the mental development of the person concerned; and that they assume a higher degree of perfection in persons of mental ability and culture than in uneducated people; while, on the other hand, retrogressive changes take place, not only as age advances, but also in diseases of the mind. This process, however, can scarcely be termed amœboid.

I have for many years past been of opinion that *the work of the brain-cell is of an electrical nature.* In 1881 I[91] drew attention to the fact that the grey cell may be appropriately likened to a galvanic battery in which an electric current is generated, and the white matter to telegraph wires, which conduct the current to any place where it may be required. Again, in 1894, I[92] compared the laws which govern the action of artificial electricity with those which rule the action of the brain-cells. The principal law of electricity is Ohm's, which is to the effect that the current strength (C) is equal to the electromotive force (E) divided by the internal or essential resistance which it encounters in the circuit of the battery (R). The formula for Ohm's law is, therefore, $C = \frac{E}{R}$. Now the action of the brain-cell (B) may be similarly expressed by saying that the energy which may be manifested by it is equal to the force evolved (F) divided by the resistance which it experiences within the cell (R). The formula for the brain-cell is therefore $B = \frac{F}{R}$. It is therefore seen that the energy of the brain-cell depends, first, as that of the galvanic battery, either upon production of force and resistance; and lack of power in, or absolute inactivity of, the brain may thus be owing either to diminished force production, or to increased resistance within the cell, in the same way as the battery-current will become much weaker by certain changes in the voltaic pair, such as rusty metals, deteriorated or decomposed exciting liquids, etc., and must eventually cease to flow unless the elements are renewed, deposits cleared off, and exciting fluids renewed. Thus damage to the brain-cell, with diminished chromophile substance, attenuated nucleus, etc., must also lead to failure of brain power, lack of decision and initiative, defective memory, and impaired mental activity altogether, and it will only be possible to resume work when waste matters are eliminated, and fresh nutritive material, with an abundance of oxygen, is supplied to it. When the zinc of the battery is completely oxidised and the exciting liquids have been decomposed, the current must disappear altogether. Similarly, when the supply of nourishment and oxygen is entirely cut off from the brain-cell, total loss of its function is the inevitable result. When a battery still contains some unoxidised zinc, and part of the exciting liquids has not been decomposed, the current will not completely disappear, but become greatly diminished in strength; and just so with the brain-cell in which the blood supply is only lessened, but not entirely cut off, there will not be absolute functional death but fatigue and impaired energy.

The brain-cell, however, is not only a producer of force like a galvanic battery, but can act also as an accumulator, becoming charged with force, and able to store it up. Where a proper balance of accumulated force is wanting, there can be no sustained power either in mental or physical work; and comparatively trivial efforts may thus lead to expenditure of the small modicum of power which may be present.

I would carry this analogy still further by comparing the *external or non-essential* resistance which, in a galvanic battery, is encountered by the current in its passage through conductors, with the external or non-essential resistance which is offered to the nervous force when travelling from the brain-cell of the cortex and sub-cortical centres through the white conducting strands in the lower levels of the brain, the spinal cord, and the peripheral nerves, and that at any portion of these conducting strands.

We have already seen that the myeline sheaths of the axones are intended to serve as insulators (p. 45), so that electric currents may be conducted along the axones without diffusion, and that the resistance to passage is five times greater in the transverse section of the axone than in its longitudinal section. There is therefore isolated conduction along the whole of the fully matured nerve-fibres up to the point where they reach the peripheral or central terminations of the sensory organs or the muscles, while the myeline sheath disappears and the axones become naked and free, allowing of the transmission of stimulation. It is in this way only that it seems possible to account for the trophic influence of the nerve-cell upon its processes as a kind of induction proceeding chiefly from the nucleus of the cell to the end of the axone, *and such action may be either electrolytic, or cataphoric, or both*, so that chemical and physical conditions suitable for the assimilation of nutritive fluid would constantly be in operation.

a. Increased Resistance.—It has been generally assumed that in failure of brain power only the production of nervous force is diminished, and little account has been taken of resistance; but the symptoms in many cases, more especially where paresis is the principal feature, seem rather to point to unduly *increased resistance* than to diminished force-production. Force seems in many cases to be still there, but it cannot be utilised by the patient, since he is unable to overcome the resistance offered to its liberation.

b. Lessened Resistance.—This may be assumed in those likewise very numerous instances in which we have to do with undue excitability and the various forms of hyperæsthesia, analogous to what we find in the frog's nerve when this has become fatigued after separation from the body, and repeated stimulation (Pflüger, Von Bezold, Wundt). In such cases resistance is so much diminished that conduction is unduly facilitated, in consequence of which the slightest stimulant elicits a violent response, which is out of proportion to the force of stimulation which has been used, and which after a time is followed by complete exhaustion.

Another reason which induces me to assume an intimate connection between failure of brain power and inefficient production of animal electricity in the living brain-cell, is the extraordinary effect which, in a large proportion of cases of this neurosis, is produced by a judicious application of artificial electricity to the suffering part. From what I have observed during a practice extending now over a very protracted period, I am inclined to think that when electricity fails to do good in cases where it appears to be indicated, this is owing either to defective diagnosis of the seat of the trouble, or to an injudicious mode of application. Accurate localisation is essential for success with this treatment. It has happened in several cases which have been under my care at various times, that no progress was perceptible while I applied the electricity to a certain area of the brain which I first believed to be affected; and that when, on further consideration of the symptoms, a different district of the organ appeared to me to be at fault, and I therefore altered the localisation of the current, a successful result was obtained. Such occurrences not only give strong support to my theory that an unsatisfactory condition of brain-currents may be improved by artificial electricity applied to the suffering area, but likewise afford a proof that the influence of suggestion, for which now anything and everything is claimed in therapeutics, does not enter to any extent as a factor into electro-therapeutics. If suggestion were the active agent, it is much more likely that it would do its work in the beginning of the treatment than after the latter had been for some time ineffectual, whereby any suggestive force inherent to the proceeding must have been lessened rather than increased.

It is much to be regretted that physiologists should have until now occupied themselves so exclusively with the electricity of the nerve and muscle, and have neglected the study of the electricity inherent to the nerve-cell. Even in the most recent work[93] on this subject we find very little more than such general statements as that active matter is electro-positive to inactive matter; that more active matter is electro-positive to less active matter, and matter whose action is lowered, is electro-negative to matter whose action is normal; that electrical changes are a measure of physiological activity; that electrical effects accompany a natural discharge of nerve-impulses, as well as the impulses aroused by all artificial stimuli, whether these be or be not of electrical origin, and that an electrical stimulus is not necessary to produce an electrical effect. Aphorisms of this kind are not likely to advance our knowledge of this important subject.

* * *

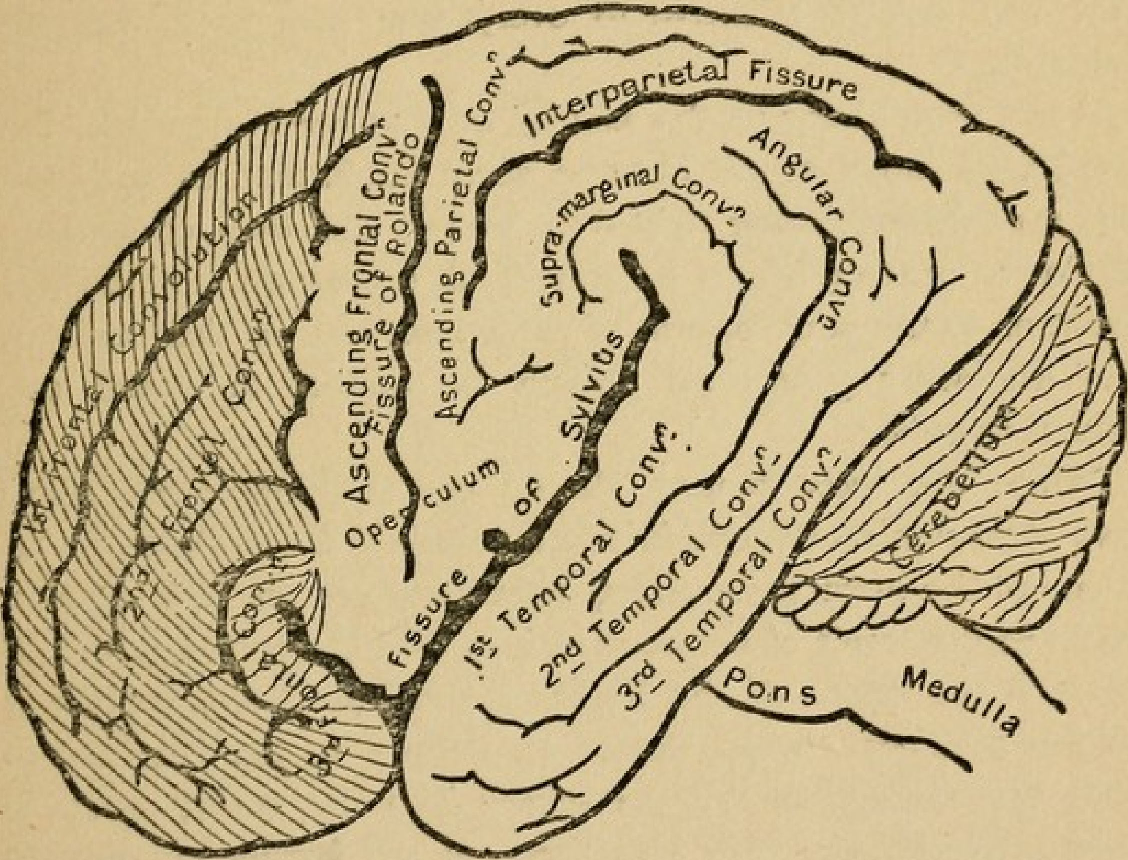
THE FUNCTIONS OF THE BRAIN.

I NOW proceed to give a short sketch of the localisation of the cerebral faculties, premising that, with regard to many of them, a fairly definite agreement has been arrived at, while with regard to others the existing diversity of opinion is likely to continue for many years to come, owing to the extreme difficulties inherent to conclusive researches in these matters.

I.—The Intellectual Sphere.

For a number of years past, the *pre-frontal lobes*, which consist of the first, second, and third frontal convolutions, have been held to constitute the chief material base of all our intellectual and moral manifestations; and although recent researches have tended to divest this area of its former proud and exclusive position in this respect, yet there can be no doubt that it plays, all the same, a leading part in our mental operations. Congenital absence or deficiency of these lobes appears to be connected with the various forms and degrees of idiocy and imbecility, and disease of, or injury to, them, later in life, affects in most cases the moral and mental faculties of the person concerned in a profound manner. It is a suggestive fact that the pre-frontal lobes are absent in the lower forms of animal life, become gradually more developed in the higher species, and are largest in man. An unusual development of them has been found to coincide with a particularly high development of intellectual power. It was formerly believed

Fig. 6.



Lateral view of the Brain. The frontal lobes shaded.

that a special evolution of certain parts of them corresponded to the presence of certain special aptitudes and talents; but the seat of these latter is now with more probability looked for in the parietal convolutions.

The principal function of the pre-frontal lobes appears to be that they enable us to fix our attention, and to concentrate our consciousness on any given subject, this being an indispensable condition for the highest order of mental activity. With regard to this point, Darwin has related an interesting story of a trainer of monkeys, who was in the habit of offering a double price for animals if he was allowed to take some of them home with him for a few days previous to purchase. When asked how he would utilise such a privilege, he said that if, while talking to a monkey, its attention was constantly distracted by trivial things which happened in the same room, the animal would be useless for training purposes, while one that was strictly attentive to everything said to it, was invaluable.

Apart from giving us the faculty of sustained attention, the pre-frontal lobes would likewise seem to furnish us with the power of distinguishing right from wrong, and thus controlling the lower centres, which by giving us sensations and desires incite us to the performance of certain actions, so that without this inhibitory power we should be unable to check our animal impulses.

While this view is now almost generally accepted, some able physiologists dissent from it *toto cœlo*. Thus Goltz,[46] who is one of the most persevering experimenters on this subject, states as the result of his observations that the cortex *in all its parts* is the organ of the higher mental functions, especially of the intellect; which latter he defines as the capacity to work up perceptions by the senses into the performance of purposive actions. For him there is no further connection between the intellect and the frontal lobes than exists between the same and any other portion of the brain; and he has found the intellect to be much more seriously impaired by the removal of the occipital area than by that of the frontal lobes.

Munk[94] has likewise arrived at the conclusion that the intellect is seated *everywhere in the cortex*, and nowhere else, being the sum and result of all images and ideas which arise from the faculty of perception inherent to the senses. Any injury to the cortex damages the intellect in proportion to its extent, causing the loss of those images or ideas which originate from the perceptions of those portions of the cortex which have been destroyed.

Edinger[53] looks upon the cortex as that portion of the brain which forms the material base of our highest mental functions. A normal condition of the cortex is indispensable for all faculties which may be acquired, almost all those which are performed with the use of images of memory, and more particularly those which are termed associations. It is the development of associations which renders it possible to perceive, utilise, and compare sensory impressions as they arrive, to connect them with others which may have been perceived at former times, and to guide our course of action according to the images of memory which may have been formerly gained. The cortex may be divided into a number of separate territories, which are functionally different. Where it first becomes plainly differentiated in animals—*i.e.*, in reptiles—it is chiefly olfactory, while in birds it is chiefly optical. In pigeons, for instance, the tractus occipito-mesencephalicus is the largest tract of the entire brain, and destruction of it renders the bird completely helpless.

Allen Starr[95] finds that there is a definite relation between the pre-frontal lobes and the higher forms of mental activity, and therefore of character and behaviour; but that for the process of thought, a healthy state of the entire cortex, and even of the white medullary matter beneath it, through which the associating fibres pass, is necessary.

Ireland[96] expresses very much the same idea by stating that "common consent rather than scientific proof has assigned the higher mental operations to the frontal regions"; and that the intelligence itself, the *φρὴν*, is in all parts of the cerebrum, "interpreting the sensations and directing the motions of the body."

Bianchi[97], whose experiments appear to have been made with particular care, and interpreted with considerable acumen, has found that removal of the pre-frontal area in dogs and monkeys causes no impairment of sensation or motion, except during the first few days after the operation, where some of the symptoms must be referred rather to shock and disturbed circulation in neighbouring parts than to loss of substance. The ultimate consequence of destruction of the frontal area is, according to him, impairment of the mental balance. This is shown—

(1) By excitement and restlessness of the animals, an incessant and aimless running to and fro, with only short and rare pauses;

(2) By want of curiosity, loss of those gestures which are peculiar to monkeys, and indifference to anything that may go on in their neighbourhood;

(3) Want of affection for other monkeys and animals, which existed previous to the operation;

(4) By diminution of sexual desire in the female, and of power in the male;

(5) By fear of noise and of other animals. A monkey, when seized by such panic, cannot be soothed, the fear being apparently owing to want of criticism, and mental depression;

(6) By deficient judgment and consideration. Such a monkey, for instance, will eat a piece of plaster of Paris only because it is nearer at hand than a piece of sugar;

(7) By voracious appetite and collection of objects without discrimination.

In disease of the pre-frontal area, such as tumour, etc., mental symptoms are generally well marked, and occur at an early stage of the disease. We find chiefly dulness, hebetude, melancholia, loss of self-control, such as childish behaviour, with undue merriment, and great tendency to fall asleep. In addition to this, the optic disc is generally more affected on one side than on the other. It seems, however, necessary that a considerable portion of the pre-frontal area should be destroyed or diseased for such symptoms to be produced; compensation by neighbouring parts may be effected when the loss has been small.

Thus, for instance, Collings[98] has recorded the case of a boy, aged eight, who had been kicked on the head by a horse, and showed a scalp wound over the right frontal eminence, in which there was about a teaspoonful of brain-matter, and some more was reported to have come out previous to admission, so that the actual amount lost was probably a table-spoonful. The boy recovered, and when he left the hospital was bright and intelligent. Seventeen months after the accident he was again examined, and found to be sharp, able to do messages and shopping correctly, and with no perceptible change of disposition.

The fore-brain also appears to contain centres for the equilibration of the body, giving to men and monkeys the faculty of their erect posture and walk; for, in tumour of these parts, the symptom known as *cerebellar ataxy*—that is, a slouching or reeling gait, swaying and staggering in standing or walking, and other disorders in the co-ordination of the movements of the lower extremities—has not unfrequently been noticed. Such symptoms do not occur in tumours of the Rolandic area, and cannot, therefore, be ascribed to the influence of the tumour on the brain in general. The term "cerebellar ataxy" is, therefore, a misnomer.

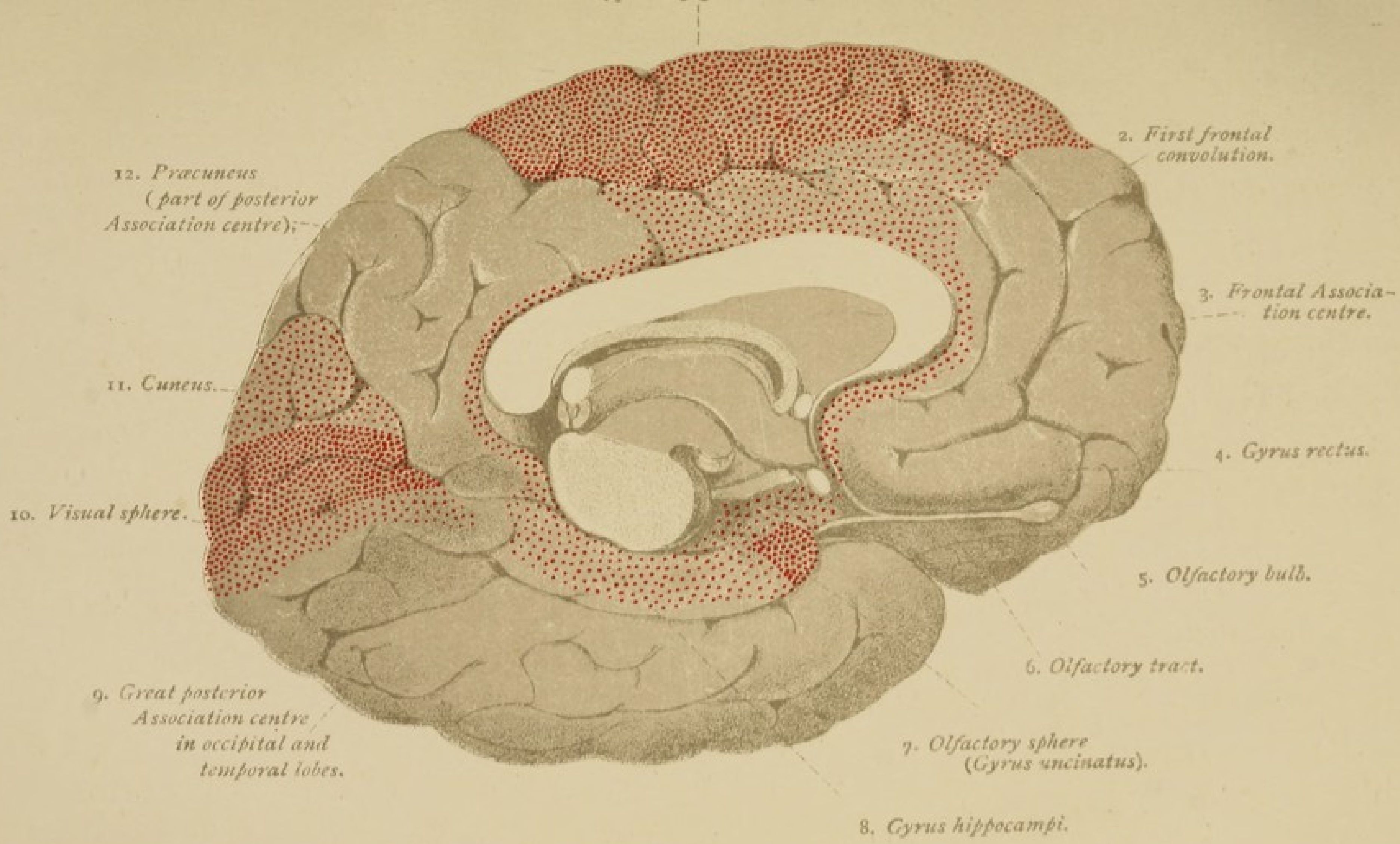
Flechsig,[25] whose masterly researches on myelination have given him an authoritative position in this department of physiology, claims a far more definite area in the brain for mental operations than has hitherto been generally assumed. According to his most recent views on this subject there are three mental or association centres in the cortex, viz., a posterior association centre, which is intercalated between the visual, auditory, and tactile spheres; a middle centre occupying the insula of Reil, and interposed between the auditory, olfactory, and tactile areas; and an anterior or frontal centre, situated between the tactile and olfactory centres.

1st, *The large posterior association centre* comprises, in intellectually gifted persons, nearly one-half of the entire hemispheres, but is much less developed in low-typed individuals. It contains the præcuneus, the entire parietal convolutions, parts of the gyrus lingualis, the second and third temporal convolutions, and the anterior portions of all three occipital convolutions. The whole of this cortical area shows a uniform type of cellular structure. With regard to myelination, the occipital zone precedes the other, and the second occipital zone convolution is particularly early developed. Focal lesions of this centre, which are often met with post-mortem, impair or destroy the faculty to understand printed or written words, to name objects which are seen or touched, or to understand their properties and to form accurate notions of one's surroundings, whether persons or things. Where there is a difficulty of recognising external objects properly, an erroneous use of them is apt to follow. The normal interpretation of external impressions being destroyed, there is naturally loss of the ideas of space and time. When such destructive disease advances, it eventually causes a complete absence of ideas, whether true or false; the thinking power is destroyed, and the patient becomes imbecile.

The gyrus supramarginalis and the upper parietal convolution have, in man, a greater development of secondary convolutions than in the highest apes; and a powerful development of the region corresponding to the tuber parietale would appear to be characteristic for the brains of highly-gifted persons, more especially the *great composers of music.* The skulls of Bach and Beethoven showed a truly astounding development in the region of the gyrus supramarginalis, while the development of frontal association centres was in these great men remarkably small.* This latter circumstance would be quite sufficient to

* I have endeavoured to ascertain whether the same peculiarity existed in the skull of Richard Wagner, but have failed in gaining the necessary information from the widow of the deceased composer, whose health is at the present time very precarious.

ASSOCIATION AND SENSORIAL CENTRES (After FLECHSIG).



explain the oddities, eccentricities, and other want of common sense, so often shown by Beethoven in the most ordinary affairs of life. Where, on the other hand, artistic talent is absent, the frontal area is often very largely developed. Rüdinger[99] has shown that in great savants like Justus von Liebig, Döllinger, Kant, Gauss, Dirichlet, and others, the parietal convolutions were enormously developed, and that by such a development the ape-fissure was seen to have been shortened, this pithecoid feature in the human brain having become more or less effaced. From all this we may fairly draw the conclusion that an abundant development of the parietal convolutions is co-existent with intellectual pre-eminence.

2nd. *The intermediate centre of association* consists of the island of Reil. This area is very abundantly developed in man, and by its peculiar type characteristic of the brain of the primates. It appears to be more especially the co-ordinating centre of language.

3rd. *The anterior centre of association* consists of the anterior half of the first and the largest portion of the second frontal convolution. These parts are also much more voluminous in man than in the highest apes. Long association-fibres connect the sentient body-sphere and the olfactory area with the fore-brain, and possibly also with other sensorial spheres. According to Flechsig, the frontal centre contains the most essential components of self-consciousness. It regulates our actions, enables us to judge our own performances, and tells us what to do and what to avoid. Disease of this centre changes the perception of the *ego* as an active being; it diminishes or destroys personal initiative, and prevents us from fixing our attention. Irritative disease of this centre causes either unmeasured self-conceit or self-depreciation, while decay of it leads to indifference, self-oblivion, and impaired judgment.

The posterior and anterior centres of association are abundantly connected with each other by means of the corpus callosum, and are thus distinguished from the insula, which is comparatively isolated. The latter is therefore of more local importance, while the former are chiefly concerned in intellectual operations. The corpus callosum allows a conjoint action of the association-centres, so that the *separation of the brain into two hemispheres is only an apparent one.* There is indeed a greater unity of action established by the associated systems of the corpus callosum than would be possible if both hemispheres had coalesced in the middle, or if the cortex of the left merged directly into that of the right hemisphere. The brain is therefore by its two hemispheres not divided into two halves, but *enabled to do double work.*

The sulci between the association centres become developed at a much later period than those of the sensory spheres and the limiting sulci. For judging as to the comparative intellectual value of the brain, it is not only necessary to consider the wealth of convolutions, but more particularly the locality where their greatest development takes place. Thus there are brains which show well-developed posterior and imperfect anterior association centres; in such there may have been talents, but no energy or wisdom. In the brains of idiots occasionally one centre of association may be well developed, while another appears wasted, and according to this there may have been partial mental defects or specialised talents. An enormous field appears therefore to be opened up here for neo-phrenological studies. Each brain is thus seen to show a physiognomy of its own, and the proportion of the sensory to the association centres is apt to vary very much in extent, the latter preponderating considerably over the former in intellectually-gifted persons.

The association centres in animals have not yet been properly studied. In mice and moles they are completely absent, so that one sensory sphere merges into the other. In beasts of prey they are small, and only in the catarrhine apes they equal in extent the sensory centres, while in man they preponderate over the latter.

As far as extent goes, it is seen that the sensory centres, *i.e.*, those portions of the cortex which are in direct communication with paths carrying sensory impressions to our consciousness, and stimulating motor mechanisms and muscles, occupy in man about one-third part of the cortex, while two-thirds of it have a higher function as mental centres, the activity of which is directed inwards.

Flechsig's researches on the brains of infants have shown that a month after birth the mental centres are totally immature and unmyelinated, while the sensory centres are then already well developed, each one of them having matured by itself independently of the others. It is only after the internal structure of the sensory centres is finished that a movement appears to spring up in the mental centres, for it is only then that numberless medullated fibres are seen to become projected from the sensory into the purely mental areas, and to connect the paths arising between the different sensory spheres ending in the cortex. The mental centres are therefore mechanisms which join the action of several sensory centres so as to become higher units. It seems reasonable to assume that in all complex mental operations the whole of the mental as well as sensory centres act together, being connected with each other by numberless association fibres. Indeed, the largest portion of the white matter of the hemispheres consists of nothing but millions of well-insulated conducting fibres, thousands of miles long, which connect the sensory centres amongst each other, the sensory with the mental, and the latter again amongst each other; and it is only this mechanism which renders the unity of cerebral functions possible.

Destruction of the mental centres invariably impairs the *memory*. This faculty appears to reside more particularly in the posterior association centre. That portion of the latter which borders on the central convolutions seems closely connected with recollections of muscular and tactile impressions, the temporal with auditory, and the occipital with visual ones.

That memory is based on material conditions is shown by the fact that certain chemical poisons, such as alcohol, may make it disappear either temporarily or permanently; the latter whenever the cortical cells and fibres have been to a great extent destroyed. Memory must adhere to the ganglionic cells because they alone are able to store up stimuli and to become charged with force, like accumulators.

II.—The Speech Centre.

This is one of the best known areas of the brain, and is situated in the left hemisphere of right-handed persons, while in the left-handed it seems generally to reside in the right hemisphere. This holds good for the principal current of speech, namely, the truly intelligent language; while a weaker collateral current appears to go through the opposite hemisphere, enabling persons who have lost the faculty to converse, to swear (emotional language), or to say "Yes" or "No," or to constantly repeat a word, or part of a sentence. One of my patients suffering from aphasia answered any question by saying "Go to wash her," and could not pronounce any other word whatever.

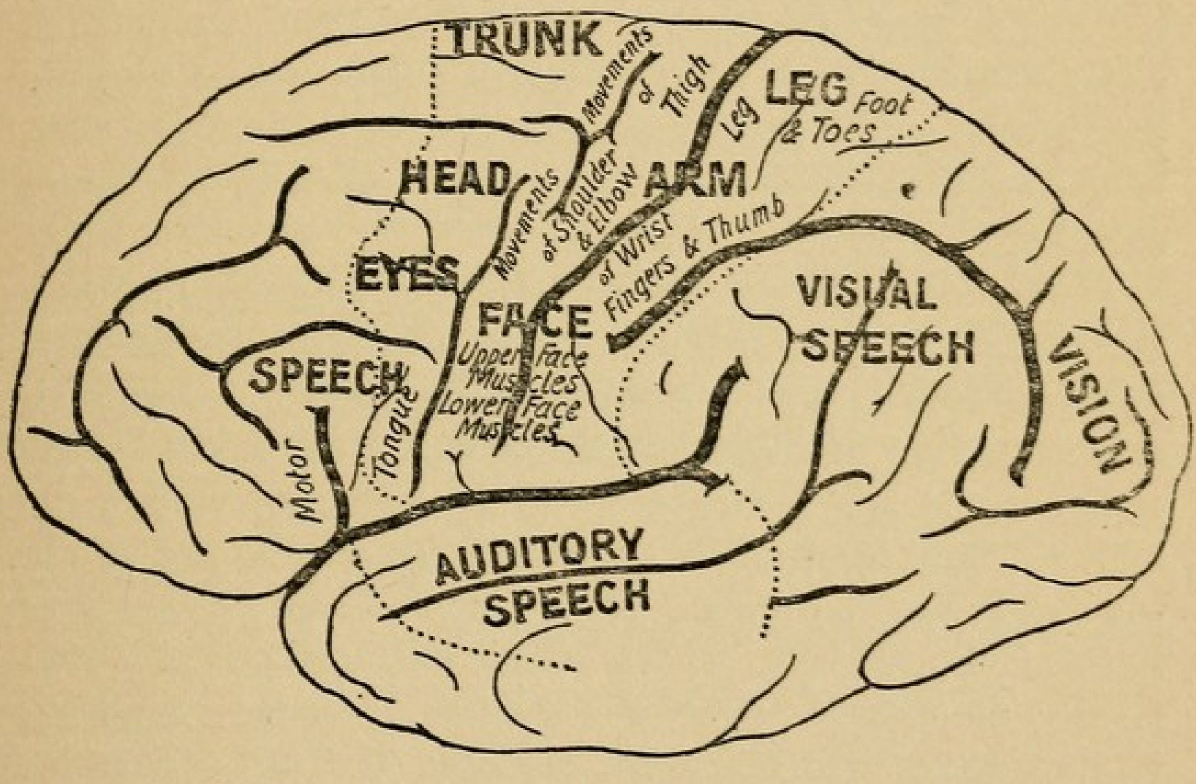
The nervous contrivances for the mechanical execution and connection of the movements of articulate speech are situated in the lower centres, more particularly the bulb and the pons, and loss of power in them, which is seen more particularly in labio-glosso-laryngeal paralysis, is known as *dysarthria* and *anarthria*.

These centres, and all the other inferior organs concerned in speaking, form, however, as it were, only the instrument on which the left hemisphere is habitually playing. Indeed the intelligent formation of syllables, words and sentences, as well as the correct appreciation of the connection which exists between written and spoken words and ideas, reside exclusively in the cortex

1. *Motor Area.*

The motor area for language is found in the posterior part of the third left frontal, or Broca's convolution. This centre co-ordinates the movements of speech, and destruction of it by disease or accident renders talking impossible (Motor or atactic aphasia). In persons who have the "gift of the gab,"

FIG. 7.



Broca's convolution is more extensively developed and complex than in persons of average or low oratorical or conversational powers. The examination of the brain of the great French orator Gambetta showed a truly marvellous development and complexity of this convolution; and if Emilio Castelar's or Mr. Gladstone's brain could be dissected, their speech-centre might be found to beat the record. It is interesting to find in Flechsig's researches the key for enabling us to understand that *great oratorical powers do by no means imply a commanding intellect*, or a harmonious development of great mental faculties, for the third left frontal convolution does not form part of the anterior association centre (p. 65). The three great orators whom I have just named have, when in power, done their countries a great deal more harm than good. Mr. Gladstone nearly succeeded in dismembering the British Empire; Gambetta's obstinacy in refusing to conclude peace at the proper moment caused the loss of two provinces to France; and Castelar, after a short lease of power, left Spain much worse than he found it, torn by faction, and a prey to anarchists. Prince Bismarck and Lord Salisbury, on the other hand, although terse speakers, have never been reckoned amongst the great orators, yet have shown by their policy that, while Broca's convolution may have only been moderately large, their great association centres of the cortex must have been splendidly developed.

The circumstance that a weak collateral current goes through the right hemisphere may serve to explain why aphasia may, to a considerable extent, be recovered from after a lesion, such as hæmorrhage or softening, has destroyed the motor speech centre in the left hemisphere. The homologous part of the right hemisphere may then be trained for speech, just as the left hand may be trained for writing. Such recoveries of language are, however, always incomplete, and generally confined to the mother tongue of the patient. A lady, aged 33, who was some time ago under my care, and had had motor aphasia and right hemiplegia from embolism of the left middle cerebral artery, had gradually recovered a fair share of conversational powers in English, but had forgotten French, German, Italian, and Spanish, which she had spoken fluently before the attack.

Motor aphasia is generally connected with *agraphia* or inability to write, but the two affections are occasionally separate. This points to the existence of distinct cerebral centres for the two faculties which are in close proximity to one another. Exner[100] has localised the faculty of writing in the posterior part of the second left frontal convolution, while other observers attribute it to the lower parietal area. It will be noted that these parts are in close connection with the centres for the face, tongue, pharynx, and larynx, which are situated in the lower third, and with the hand centre in the middle third, of both central convolutions.

The condition of a patient who cannot speak but can write, is now sometimes called *aphemia*, by which term Broca originally designated the affection for which Trousseau afterwards proposed the now generally accepted word "aphasia." The faculty of intelligent pantomime or gesticulation resides apparently in close propinquity to the motor centres of speech and writing, for if disease of this area is somewhat more extensive, pantomime is likewise lost (*amimia*). Persons, however, who have lost their language may still be able to play chess, backgammon, and whist, and they have been observed to cheat at cards with some ingenuity. They may also be sharp in business matters, facts tending to show that speech and intellect do not run in identical grooves.

2. *Sensory Speech-Area* (Fig. 7, p. 69).

This area has a much larger extent than the motor speech-area, as both sight and hearing are involved in it. Destruction of the sensory speech-area by disease or accident entails what is now known as *amnesia*, or amnemonic aphasia. Kussmaul[101] has distinguished two principal varieties of it according as the visual or auditory centre is affected, and has called these affections word-blindness and word-deafness.

a. In *word-blindness*, which is also called alexia, the patient cannot read, or understand written or printed words, although his sight may be good, and he may be able to speak and to write quite well. I have seen a number of patients who were able to converse freely, and could cover sheets of paper, writing either at my dictation, or putting down their own thoughts, yet were immediately afterwards unable to read a single word of what they had just before so fluently written. This word-blindness appears to be due, either to a lesion of the visual speech-area (Fig. 7, p. 69), which is situated in the angular gyrus in the left lower parietal region, or to destruction of the conducting fibres which connect this centre with the third left frontal convolution.

b. Word-deafness is that condition in which the patient may be able to speak and hear quite well, yet cannot understand anything that is said to him, because the auditory speech-area (Fig. 7, p. 69), in which the memory of spoken words is stored up, is destroyed. This faculty appears to reside in the posterior part of the first and second left temporo-sphenoidal convolutions in right-handed persons, and is lost either by destruction of that centre, or of the fibres which associate it with the third left frontal convolution. Such patients are sometimes believed to be deaf or insane, because they have lost the comprehension of spoken words, and may speak words in a senseless connection, but the intellect and sense of hearing may be perfectly normal all the same.

c. Paraphasia, or a delirium of words, is a term applied to the condition in which a patient is able to articulate, to express himself in writing, to understand everything that is said to him and given him to read, yet where he has lost the power of connecting ideas with spoken words, so that when he attempts to talk, or to read aloud written or printed matter, an unintelligible jargon or gibberish is the result. The exact localisation of this condition has not yet been ascertained.

3. *Association Centre of Speech.*

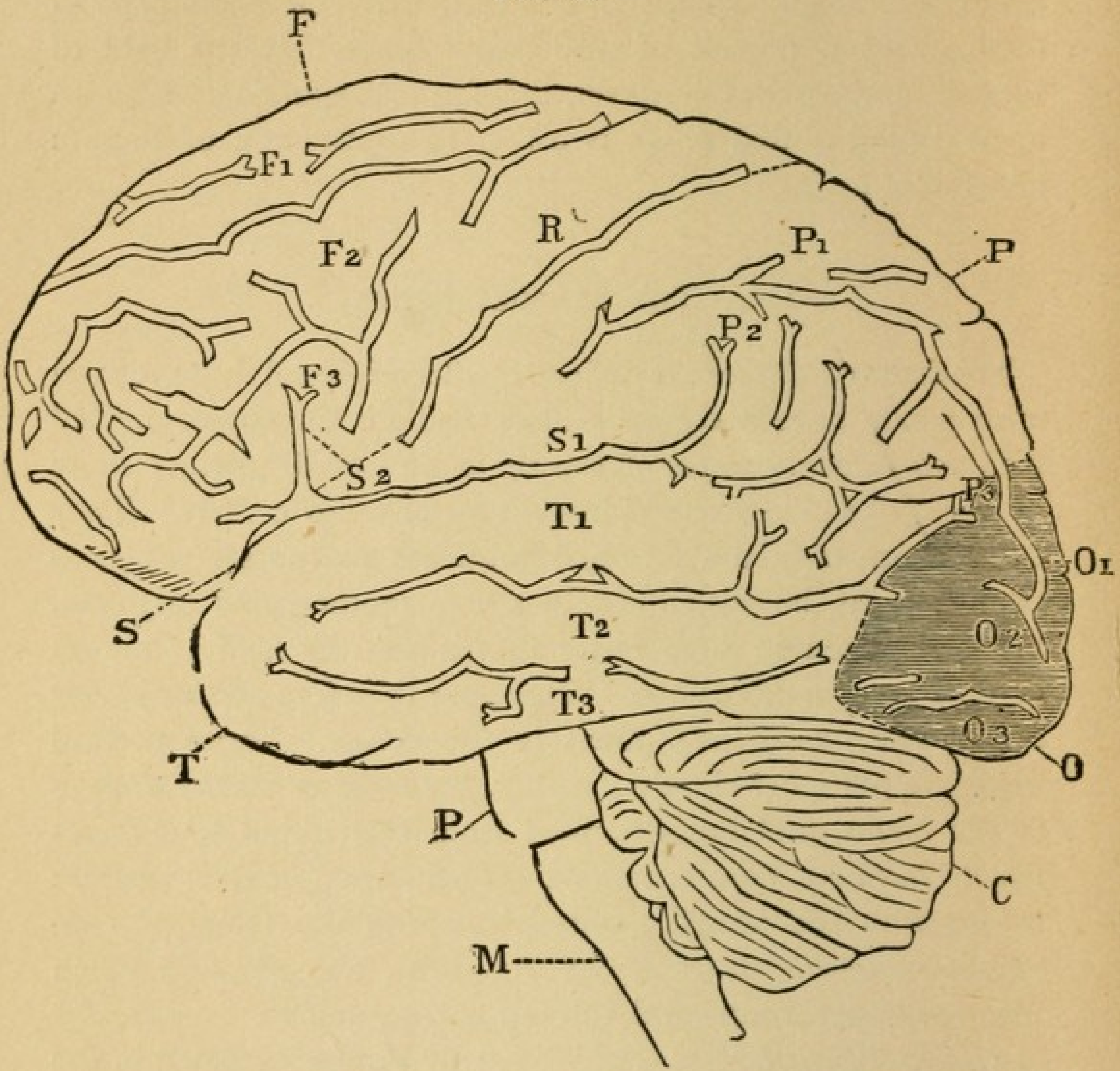
According to Flechsig[25] the insula of Reil is the centre by which all cortical areas, motor as well as sensory, which participate in the function of intelligent language are joined to a homogenous whole. Aphasia from disease of the insula has been known to occur before, but was generally believed to be an "aphasia of conductivity," (Lichtheim) and to originate from disease of associating fibres. In the light of Flechsig's researches, however, this form of aphasia is seen to be as central as that which is owing to destruction of Broca's convolution.

III.—The Sensory Spheres.

The sensory spheres are defined by Flechsig as all those cortical areas which have a corona radiata, and are thereby connected with sub-cortical centres of the brain and cord, whether these be nuclei of sentient and motor nerves or reflex centres. They contain not only the terminal branches of the sensory connecting paths, but also the cells where motor paths originate, being arranged in such order that a sensory field is always contiguous to a motor one. There are therefore *neither purely sensory nor purely motor* areas in the cortex. These cortical fields are not lying closely together, *but form, as it were, islands in the cortex*, and are separated from each other by spheres which have no corona radiata. There are four such islands: we *see* with the occipital lobes, *hear* with the temporal convolutions, *smell* with the gyrus uncinatus, and *feel* and touch with the upper frontal and anterior parietal region.

1. *The Visual Sphere* (Fig. 8) was by Ferrier[48] located in the angular and supra-marginal lobe, but it is now generally admitted that it is situated in the *occipital lobe*. Allen Starr, Willebrand, Seguin, Berger, Bouveret, Chauffard and others have shown that one-half of each retina is represented in the corresponding occipital lobe, and that a lesion in one lobe produces hemianopsia, the blind field of vision being on the opposite side of the lesion. Bilateral lesions of the occipital lobe have been stated to produce total blindness, or, more correctly speaking, double hemianopsia; but Forster,[102] Magnus,[103] and others, have found that bilateral homonymous

FIG. 8.



Lateral view of the Brain.—The occipital lobes shaded.

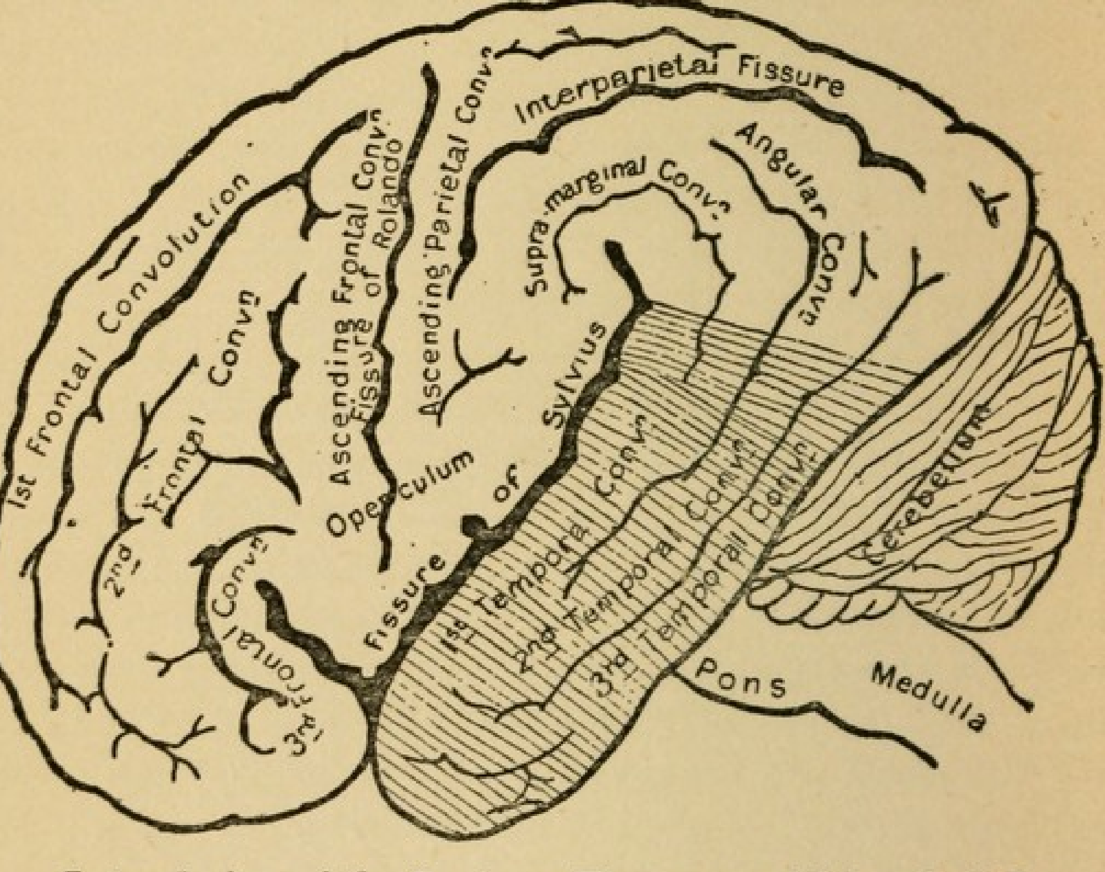
M—Medulla. P—Pons. C—Cerebellum. F—Frontal or anterior lobe of the brain; seat of the intellect. F^1 F^2 F^3—First, second, and third frontal convolutions. R—Fissure of Rolando, dividing the frontal from the parietal lobe. S S^1 S^2—Fissure of Sylvius. S^1—Horizontal branch of it, dividing the parietal from the temporal lobe. S^2—Ascending branch of it, separating the frontal from the temporal lobe. P—Parietal lobe, constituting the motor area of the hemispheres, or the psycho-motor centres. P^1 P^2 P^3—First, second, and third parietal convolutions. T—Temporal lobe; seat of conscious sensations and perceptions; centre for the organs of sight, smell, hearing, taste, and touch. T^1 T^2 T^3—First, second, and third temporal convolutions. O—Occipital lobe; seat of the animal propensities. O^1 O^2 O^3—First, second and third occipital convolutions.

hemianopsia does not lead to complete loss of sight, but that a small central visual field remains active, by means of which objects may be recognised if they fall within the sphere of it. On the other hand, the appreciation of the position of things in space is lost in such cases, and this appears to constitute the difference of cortical blindness from ordinary blindness due to disease of the eye, in which that faculty remains unaltered. Flechsig[25] has found that the macula lutea is only in direct connection with the corpus geniculatum externum, but not with the anterior corpus quadrigemium nor the thalamus opticus, which are only connected with the peripheral parts of the retina. The fibres of the corpus geniculatum terminate exclusively in the wall of the calcarine fissure, and it is therefore in that part that the cortical region belonging to the macula lutea must be sought.

2. The *Auditory Centre* (Fig. 9) is, according to Ferrier, situated in the superior temporo-sphenoidal convolution; but Luciani and Munk[105] find that it is contained in the whole of the temporal lobe. When this lobe is faradised the animal is seen to prick up his ears and assume the attitude of listening, just as it does when a sudden noise is made close to its ear. In those animals whose habits render their safety dependent upon the keenness of their sense of hearing, as, for instance, the wild rabbit and the jackal, faradisation of that part causes not only pricking of the ears and listening, but also a quick jump to the side, as if to escape from some danger which would be announced by a loud or unusual noise. Each ear appears to be, like the eye, connected with both hemispheres, so that lesion of one temporal lobe only leads to partial deafness, while destruction of both lobes would cause absolute deafness. Munk distinguishes in the temporal lobe a central portion, destruction of which produces *mental* deafness (Seelentaubheit), where spoken words cannot be recognised, and surrounding portions, removal of which entails *cortical* or total deafness.

Flechsig[25] has found in infants soon after birth that the transverse convolutions of the temporal lobe, which are situated in the depth of the fossa Sylvii, contain terminal stations of the nervous cochleæ, and that these convolutions are to be looked upon as the roots of the first temporal convolution, into which they merge without any definite limit.

FIG. 9.



Lateral view of the Brain.—The temporal lobes shaded.

Myelination proceeds first and foremost in the anterior transverse part of the first temporal convolution, which has therefore to be looked upon as the principal centre of hearing.

3. *The Olfactory Sphere* has likewise been differently located by different observers. Ferrier[48] found it in the subiculum cornu Ammonis, or the top of the temporal lobe, destruction of which in an animal appeared to him to cause loss of smell, while faradisation of it was followed by sniffing. Munk[94]

objects to this *toto cælo*, and Schäfer has destroyed the top of that lobe without causing loss of either smell or taste. That the faculty of smelling is, however, in some way connected with the sphenoidal lobe is shown by the fact that Gratiolet[104] found it most largely developed in animals which have a very keen sense of smell, such as dogs, cats, and rabbits, while Gudden noticed arrested development of this lobe in consequence of the removal of the olfactory bulb.

According to Flechsig, the gyrus uncinatus has a definite connection with the sense of smell, but it has not yet been possible to define the limits of this centre. The gyrus hippocampi is also closely associated with the olfactory area, but it is doubtful whether it takes an actual part in olfactory perceptions.

4. *The Somæsthetic Area* (Körper-Gefühls-Sphäre, Munk)* is the great sensory centre which receives the impulses associated with pain, touch, temperature, muscular sense, etc. The posterior limit of this area coincides with the posterior border of the posterior central convolution, and the paracentral lobule. The parietal convolutions do not belong to it. The tracts conveying the somæsthetic impulses pass from the internal and external capsule to the Rolandic convolutions, the inferior frontal, and portions of the middle and superior frontal convolutions, as well as the insula, the gyrus fornicatus, and the gyrus hippocampi. The whole area is thus seen to be a most extensive one, considerably surpassing that of the higher apes.

The Rolandic convolutions are, therefore, not simply motor centres (Charcot's "zone motrice"), as was formerly believed, but they also play an important part in the general sensibility of the body (kin-æsthetic area, Bastian). They are distinguished by containing giant pyramidal cells, which are so large that in

* Sir William Turner[106] has erroneously stated that this term originates with Flechsig, for it was first introduced by Munk,[105] and afterwards adopted by Flechsig.[25]

good sections they can be seen with the naked eye. They therefore occupy a unique position in the cortex, and are indeed analogous to the large cells of the anterior cornua of the cord. They serve the pyramidal tracts, which receive the longest central fibres altogether, being up to 50 cms. long. Faradisation of the Rolandic area causes movements in the opposite half of the body, while destruction or removal of it leads to paralysis in the opposite side. The greater the quantity of cortical matter removed, the more striking is the loss of power in the corresponding parts of the body. The motor area is more extensive and highly developed in the left than in the right hemisphere, because the right hand and arm are more used and better trained than the left. The centres for the movements of the different parts of the body have been carefully mapped out by Hitzig,[107] Ferrier,[48] Carville, Duret, Beevor,[108] Horsley,[109] Semon,[110] Schäfer, Eberstaller, and others; and it has been shown that there are definite and separate areas for the movements of the head and eyes, the face, tongue, pharynx, and larynx, and the upper and lower extremity.

a. The centre for turning the *head* and *eyes* (Fig. 7, p. 69) to the opposite side is a very extensive one, situated in front of the ascending frontal convolution, and reaching all the way down from the median line above to the fissure of Sylvius below. By some observers, however, this centre is placed in the posterior part of the second frontal convolution. The large extent of this area is accounted for by the circumstance that turning the head and eyes in the direction of a desired movement precedes habitually all volitional movements of the limbs. The head-area is above, and the eye-district below.

b. The centre for the movements of the *face*, *tongue*, *pharynx*, and *larynx* (Fig. 7, p. 69) is situated in the lower third of both central convolutions. The area for the opening of the eyelids and the elevation of the angle of the mouth is found in the upper part, and that for retraction of the angle of the mouth and opening the latter, in the lower part of the region mentioned; while mastication and the movements of the pharynx and larynx are controlled by a district more forward and downward, the latter being close to the speech-centre.

c. The movements of the *upper extremity* (Fig. 7, p. 69) are under the influence of centres occupying the middle two-fourths, or, according to others, the middle third of the two central convolutions. These centres are so arranged that the one for the shoulder is in front, while the districts for the elbow, wrist, fingers, the index and the thumb, follow in the order mentioned, in a direction from before backwards.

d. The movements of the *lower extremity* (Fig. 7, p. 69) are controlled by centres occupying the upper third of the two central convolutions, including the paracentral lobule where they join, the area for the thigh being most in front, and being followed by those for the knee, ankle, the big and the small toes, in the order mentioned, in a direction from before backwards.

Destructive lesions of these sensori-motor centres, such as softening, hæmorrhage, etc., cause crossed paralysis of the muscles controlled by them; while irritant lesions, such as inflammation, tumours, etc., may produce crossed unilateral convulsions (Jacksonian epilepsy). Féré[111] has aptly compared the motor portion of the cortex to a kind of confederation of organs which, on the one hand, enjoy a certain degree of autonomy, while, on the other, the possibility of generalised paralytic or convulsive phenomena shows that there is also a degree of solidarity between all parts of this confederation. None of them can, therefore, be injured without entailing suffering on the whole; neighbouring parts of the same hemispheres, or homologous parts of the other hemisphere, however, may undertake the duties of a centre which may have been destroyed, and therefore fallen out of the rank, either immediately after, or some time subsequently to, the destruction of such a centre. There is, therefore, no hard-and-fast line drawn regarding these several areas; on the contrary, each special district constitutes the focus of a movement, and there is further representation of the same in the neighbouring centres as well, which gradually diminishes in force as the distance from the focus increases. (Horsley.) Each movement has, therefore, first, a specially limited, and, second, a more widely diffused representation in the cortex. Removal of a small area may for this reason not completely paralyse, but only weaken, the movement of the part more especially represented in that district, or, if there has been paralysis at first, it may be recovered from later on.

Munk[105] distinguishes between so-called "general movements," such as walking, running, getting up, climbing, jumping, etc., which are governed by the principal lower centres, and are not lost through removal of the cortical centres, and "separate movements," which are only possible when the cortical centres are acting. A monkey, for instance, who is deprived of his left cortical motor centres, may appear nearly paralysed immediately after the operation, yet may move his right limbs some time afterwards very well in conjunction with other parts of the body; but, on the other hand, any neat and skilled separate movements of the extremities by themselves are completely and permanently lost. Again, a dog whose cortical centre for the foot has been removed may still feel pain, but is unable to localise it. The reflexes for contact, which require sensations of locality and pressure, are lost, while the common reflexes, such as we see them in feebly narcotised animals, or in such as have only a spinal cord left, are preserved. It is, therefore, seen that the somæsthetic area constitutes a large cortical field, which greatly surpasses in extent all the other sensory centres, and is by Flechsig believed to be the principal base of consciousness. In this field the body is, as it were, once more reflected in its entire extent, and all movements which serve for the satisfaction of bodily wants, such as swallowing, mastication, breathing, locomotion, prehension of external objects, etc., may volitionally or reflexly be produced from it. It is also the seat of the sexual desire, and of hunger and thirst.

IV.—The Centrum Ovale, Corona Radiata, and Internal Capsule.

Three different kinds of white medullary fibres proceed from the grey cortex in different directions, and are intended for different purposes. These are :—

1st. *Associating fibres*, which pass from certain points of the cortex to other points in the same hemisphere, so as to establish a communication between different centres on the same side. Destruction of such associating fibres may lead to annihilation of the function of centres connected by them, even where the grey matter of the centre may be intact.

2nd. *Commissural fibres*, which are intended to connect homologous parts of the two hemispheres, the principal one of these being the corpus callosum ; and

3rd. *The corona radiata*, or descending or converging fibres, which pass from the cortex to the central ganglia, the pons, bulb, and the spinal cord, where they form the pyramidal and other tracts.

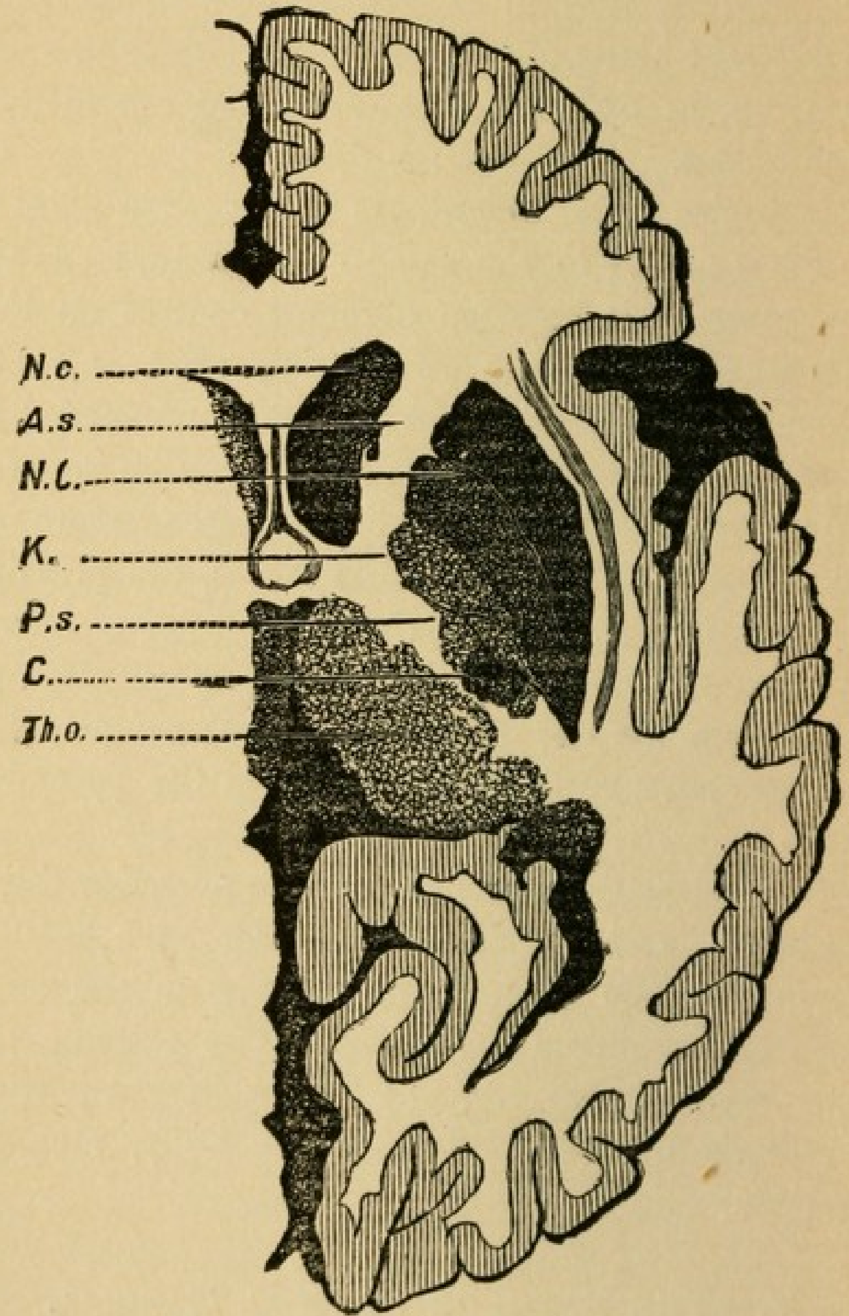
The internal capsule is excitable in the posterior third of its hinder segment, and Horsley and Beevor have localised the representation of the different movements of the head, eyes, etc., in different points of this part. The extreme posterior end of the capsule is sensory, and lesions in that part produce hemi-anæsthesia of the opposite of the body, including the special senses.

V.—The Basal or Central Ganglia.

The Basal or Central Ganglia, viz., the *corpus striatum* and the *optic thalamus*, are portions of the grey matter the function of which has not yet been definitely ascertained.

Lesions of the corpus striatum which were formerly believed to produce the ordinary form of hemiplegia, only appear to cause such symptoms when they involve at the same time the internal capsule, viz., hemiplegia when the lesion is more in

FIG. II.



Internal Capsule.

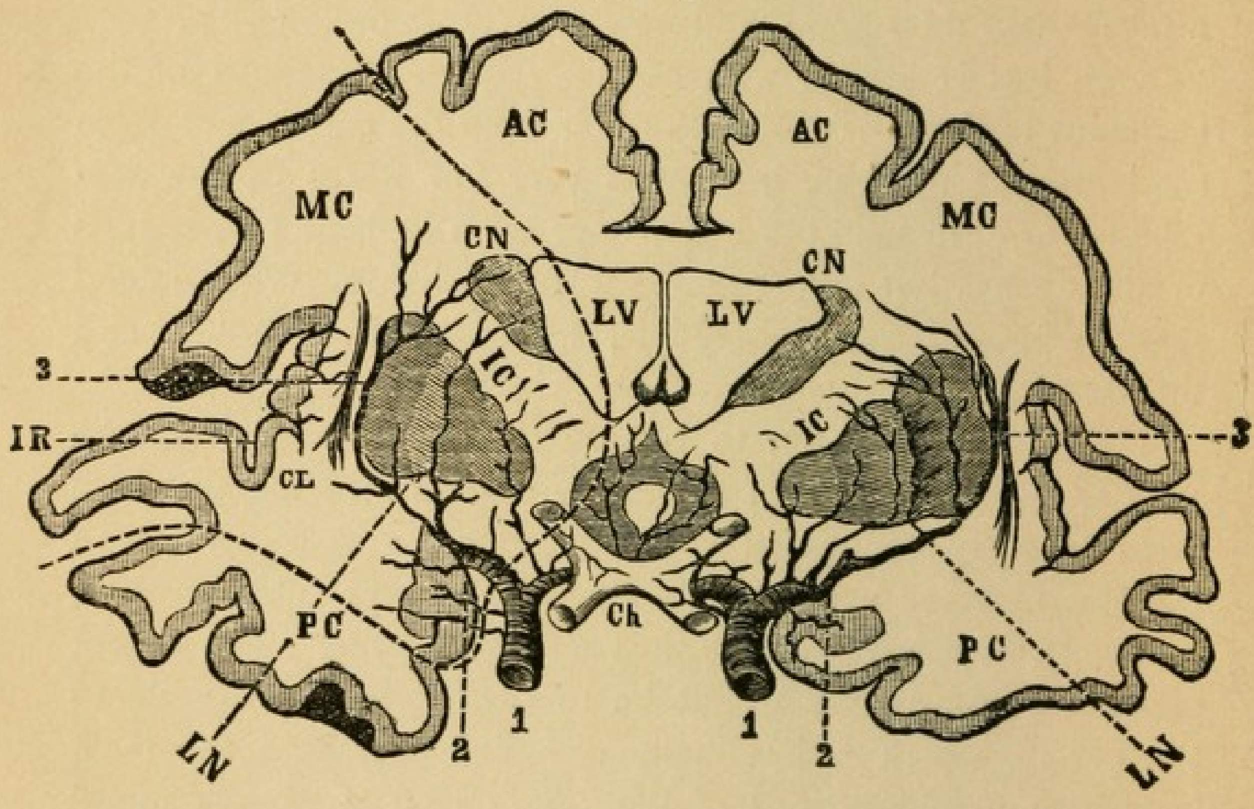
N. c.—Nucleus caudatus. *A. s.*—Interior segment of the capsule. *N. l.* Nucleus lenticularis. *K.*—Knee of the capsule. *P. s.*—Posterior segment. *C.*—Clot. *Th. o.*—Thalamus opticus.

front, and hemi-anæsthesia when it is further behind. The part has, however, a definite relation to the *temperature of the body*, for when a certain place in it is punctured, the result is a considerable elevation of temperature, which may rise up to 106°, and remain so for many hours. There is increased consumption of albumen and exchange of gases in animals thus treated, but they do not appear to be actually ill; they are lively and eat well, and show what Volckmann used to call aseptic fever. Löwy and Richter[112] have shown that such a fever often does good, and may protect or prolong life.

Even less is known with certainty of the functions of the thalamus opticus. It receives fibres from the cortex and from the lenticular nucleus, but sends very few fibres downwards. Disease or destruction of it does not seem to lead to paralysis or anæsthesia, but may apparently cause homonymous lateral hemianopia, crossed amblyopia, athetosis, hemichorea, and unilateral tremor.

There is some reason to believe that both central ganglia may have the function of rendering certain movements which are intimately connected with sensations, and which are in the first instance excited only by volition and consciousness, gradually, as it were, mechanical and automatic. The object of such a contrivance would be to save time and trouble to the cortex, which is habitually occupied only with the most important manifestations of life. The central ganglia might therefore, be looked upon as the confidential servants or private secretaries of the hemispheres, and undertake a good deal of drudgery in order to leave the grey surface at liberty for the finer and more difficult work which falls to our lot in life. Thus we have in childhood and youth to learn the actions of walking, talking, writing, dressing, dancing, riding on horseback, decent eating and drinking, singing, playing on musical instruments, etc., by countless conscious efforts on the part of the hemispheres; and full attention is necessary in the beginning in order to enable us to carry out such movements in a proper manner. But the older we grow, and the more frequently we have directed our minds to all these different forms of actions, the less effort will eventually be required on the part of consciousness and volition; and ultimately all such movements will be performed automatically, without much, if any, attention being paid to them on the part of the grey surface of the brain. A man who is in the habit of writing much, never

FIG. 13.

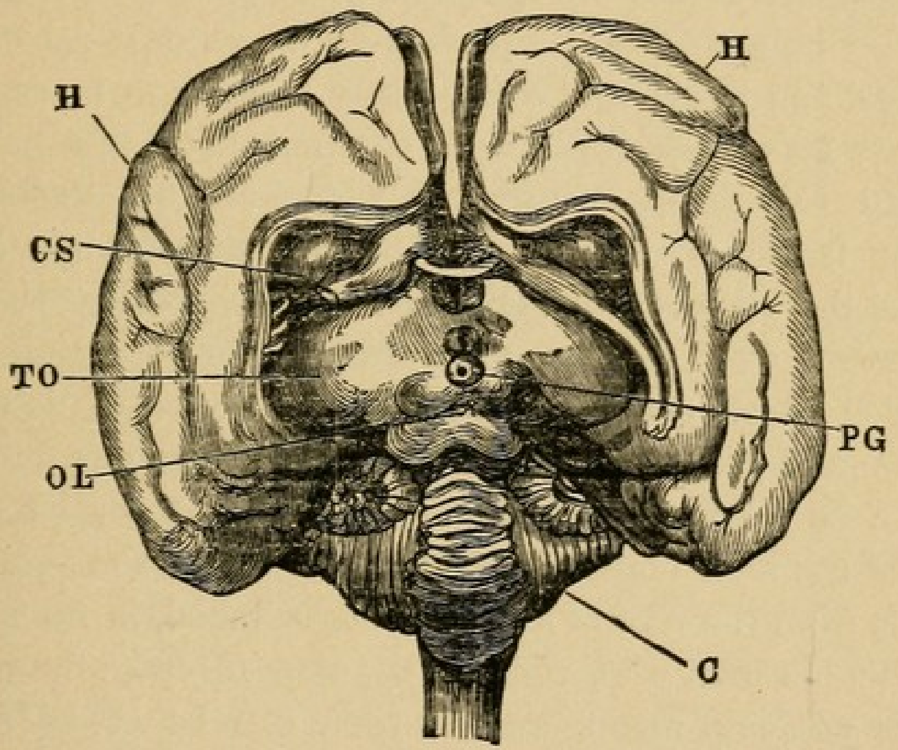


A C—Sphere of the anterior cerebral artery. M C—Spheres of the middle cerebral artery. P C—Sphere of the posterior cerebral artery. C N—Caudate nucleus. L V—Lateral ventricles. I C—Internal capsule. L N—Lenticular nucleus. Cl—Claustrum. I R—Island of Reil. Ch—Chiasma of the optic nerves. 1—Internal carotid artery. 2—Middle Cerebral (Sylvian) artery. 3—Lenticulo-striated artery.

thinks of the way in which he forms his letters on the paper, over which his pen seems to fly quite mechanically. The same holds good for the various kinds of needlework, embroidery, playing the piano, the violin, etc. If each time we do anything of that sort, a conscious effort were necessary for all the different parts of which the action is composed, the time at our disposal would not suffice for an hundredth-part of the work which we actually get through in our life; and some forms of activity, such as finished piano or violin-playing, would be utterly impossible. Flechsig has calculated that in a brilliant piano performance, not less than 100,000 nerve-fibres must be active.

A key is thus afforded for the comprehension of many singular occurrences which would otherwise be quite inexplicable. A

FIG. 14.



Central ganglia in the dog.

H—Hemispheres of the brain. C S—Corpus striatum, T O—Thalamus opticus; cential ganglia of the brain. P G—Pineal gland. O L—Optic lobes. C—Cerebellum.

pianist, for instance, is playing one of Beethoven's sonatas by heart, yet thinks all the time of his coming trip to Switzerland, or something else utterly irrelevant to that which he is doing; that is, the central ganglia play the sonata, while the cortex is busy elsewhere. In such a case, however, it would no doubt be noticed that the playing, although correct, would be more or less devoid of expression; for in order to accomplish that, cortical attention is required.

A very worthy country parson told me some time ago that, when he reads prayers at Church, he does so quite as an automaton, for his mind keeps wandering all the time in entirely different directions.

Somnambulism and other automatic conditions, which may occur through derangement of the nervous centres, may be similarly explained. The lower centres are habitually under the absolute control of the grey surface; yet this balance of power may be temporarily disturbed by illness or exhaustion of the cortex, and the central ganglia may then begin to run riot. What may take place under such circumstances may be aptly compared to certain occurrences which are not uncommon when the family is out of town, and the servants are left in charge of the house. Supposing the hemispheres to have lost their control over the lower centres, elaborate actions may take place which may have all the appearance of deliberate intention, and yet for which the person who commits them can no more be held responsible than the absent master of the house for the misdoings of his servants. The somnambulist, who falls from the roof of a house and is killed, is no more a suicide than a man who, while in the state of epileptic vertigo, commits robbery, arson, and murder, can be called a truly responsible criminal. The legal mind has not yet been able to grasp the full significance of these facts, as shown by conviction to penal servitude of persons who should have been sent to hospitals or asylums.

The phenomena of hypnotism are likewise due to temporary paralysis from induced sleep of the cortex, and to consequent action of the lower centres, which latter is in this case determined by the suggestibility of the subject operated upon, and the suggestive power possessed by the operator.

VI.—The Meso-Cephale, or Mid-Brain,

consists of the corpora quadrigemina or optic lobes, and the pons. These organs are concerned in the maintenance of the equilibrium of the body, for animals lose this power as soon as the mid-brain is destroyed.

In disease of the corpora quadrigemina, a peculiarly unsteady reeling gait, partaking of the character of ataxy, is observed, with incomplete bilateral paralysis of certain of the ocular muscles supplied by the third nerve. Lesions of the anterior part of the corpora quadrigemina are almost invariably associated with loss of sight, and immobility of the pupils.

The mid-brain also appears to contain the *emotional centres* for exhibiting the feelings of fear, terror, pain, pleasure, etc. Frogs, in which the higher centres have been removed, may, by the aid of the pons and optic lobes, still croak when stroked across the back; and croaking in the frog is the expression of comfort. In ourselves laughing, crying, and other expressions of the affections, are quite involuntary and independent of reflection, although they may be to some extent inhibited by the cortex. It is probable that the feelings of despair, hopelessness, alarm, want of confidence, and the different forms of fear, such as agoraphobia, etc., which are so commonly noticed clinically in cases of failure of brain power, may be owing to depression or undue excitability in these emotional centres.

VII.—The Pituitary Body, Hypophysis of the Brain.

This part has, on account of its peculiar position and structure, been a favourite study for anatomists and physiologists from the time of Willis, Vieussens, and Ridley, up to a recent period, when Virchow, W. Müller, Frey, Pereweschko, Ecker, Luschka, Sapolini, Henle, Leydig, Horsley, Gley, Marinesco, Kupffer, Berkeley, and many others have investigated it with the greatest care and attention. Virchow[113] calls it an "enigmatical organ," but draws attention to the fact that it ranks as nearly the most constant formation in the whole series of vertebrates, and that it preserves its relation to the sphenoid bone with the greatest persistence. He therefore looks upon it as an essential link in the development of this class of animals. Wilhelm Müller[114] was convinced that the gland has some very definite functions to fulfil, which are not dispensed with as the animal organisms become more perfect; for only on this supposition does the continued transmission of this organ through the order of vertebrates, with the retention of all its essential attributes, become intelligible. Ecker,[115] on the other hand, confesses that we lack the very first ideas on the subject of its functions, and Sapolini[116] states that it constitutes a problem, the solution of which we do not possess—in short, that the function of the gland is still a myth. More recently v. Kupffer[117] has come to the conclusion that the hypophysis consists of three different organs—viz., an epidermoid gland, an endodermal formation, and a tubular gland, which latter springs from the floor of the third ventricle, and which he calls infundibular gland. While some authors, such as Krause and Cajal, have described nerve-fibres and cells as occurring in the small lobe of the hypophysis, Kölliker[15] has never succeeded in discovering any true nervous elements in it, either in the newly-born infant or the adult; and has come to the conclusion that the structures which have been thus described are really parts of the neuroglia and cells of the ependyma. Lloyd Andriezen[118] considers that the pituitary body has an important trophic influence on the nerve tissues, enabling them to take up and assimilate oxygen from the blood-stream, and to destroy and render innocuous the waste products of metabolism by oxidation. He considers that ablation or destruction of the gland would cause mal-assimilation of oxygen by the nerve-tissues, and insufficient destruction, and therefore accumulation, of waste products. The symptoms would be depression and apathy, muscular weakness, loss of fine co-ordination and equilibration; the development of twitchings and spasms of the muscles; a want of sufficient heat production and subnormal temperature; a wasting of the body tissues; compensatory polypnœa, or attacks of dyspnœa, and rapid progress towards death. The pituitary gland would therefore bear a physiological relationship to the thyroid body, both organs showing a parallelism in their early evolution in vertebrate animals.

This theory appears to have been foreshadowed in the singular work of Swedenborg,[119] on the brain, in which it is stated, in the peculiar language of that day, that this gland is the terminus of the work of the brain, that the welfare of the whole system depends upon it, and that it is the *arch-gland* of the whole body, changing the gross, thick, sluggish and pituitous blood into a most refined virgin liquid, newly wedded to an abundant supply of spirits.

VIII.—The Cerebellum (Fig. 8, p. 74).

Gall[24] believed this organ to be the seat of the reproductive faculty and desire, but we look upon it now as one of the chief centres for maintaining the equilibrium of the body. The cerebellum appears to have little or nothing to do with reason, volition, or consciousness; for animals which are deprived of the higher centres, yet left in possession of the cerebellum, do not show any spontaneity of desire or action, and will, for instance, die of starvation with the utmost composure. If, however, the cerebellum be removed, the animal will move about as if it were drunk; it is not paralysed, and endeavours to carry out certain movements, but there is an utter want of precision; and even the most earnest efforts do not succeed in steadying it. The cerebellum being in contact with all the muscles, tendons, and joints, as well as the semicircular canals, registers every change in the position of all moveable parts of the body, and produces an image of them, so that useful movements of the body may occur without co-operation of external sensory impressions.

Symptoms which have been clinically observed in cases where a cerebellar hemisphere was absent, are an unsteady gait, weakness in the lower extremities, nystagmus, vertigo, impaired speech and intellect, and polyuria. These, however, are not by any means invariable, for Neubürger and Edinger[120] have recently described a case of almost total absence of the right cerebellar hemisphere, in a man aged 46, in which there had been a complete absence of nervous symptoms, except that the head had always been turned towards the left side.

Risien Russell[121] has recently found that in addition to the function just mentioned, the cerebellum has the faculty of energising the cortex and the spinal cord; for it diminishes the excitability of the cortical centres of the opposite side, and controls the action of the spinal centre of the same side. Removal of one-half of the cerebellum is followed by rigidity of the muscles and exaggeration of the tendon reflexes in the limbs of the same side. Removal of the whole organ causes:—

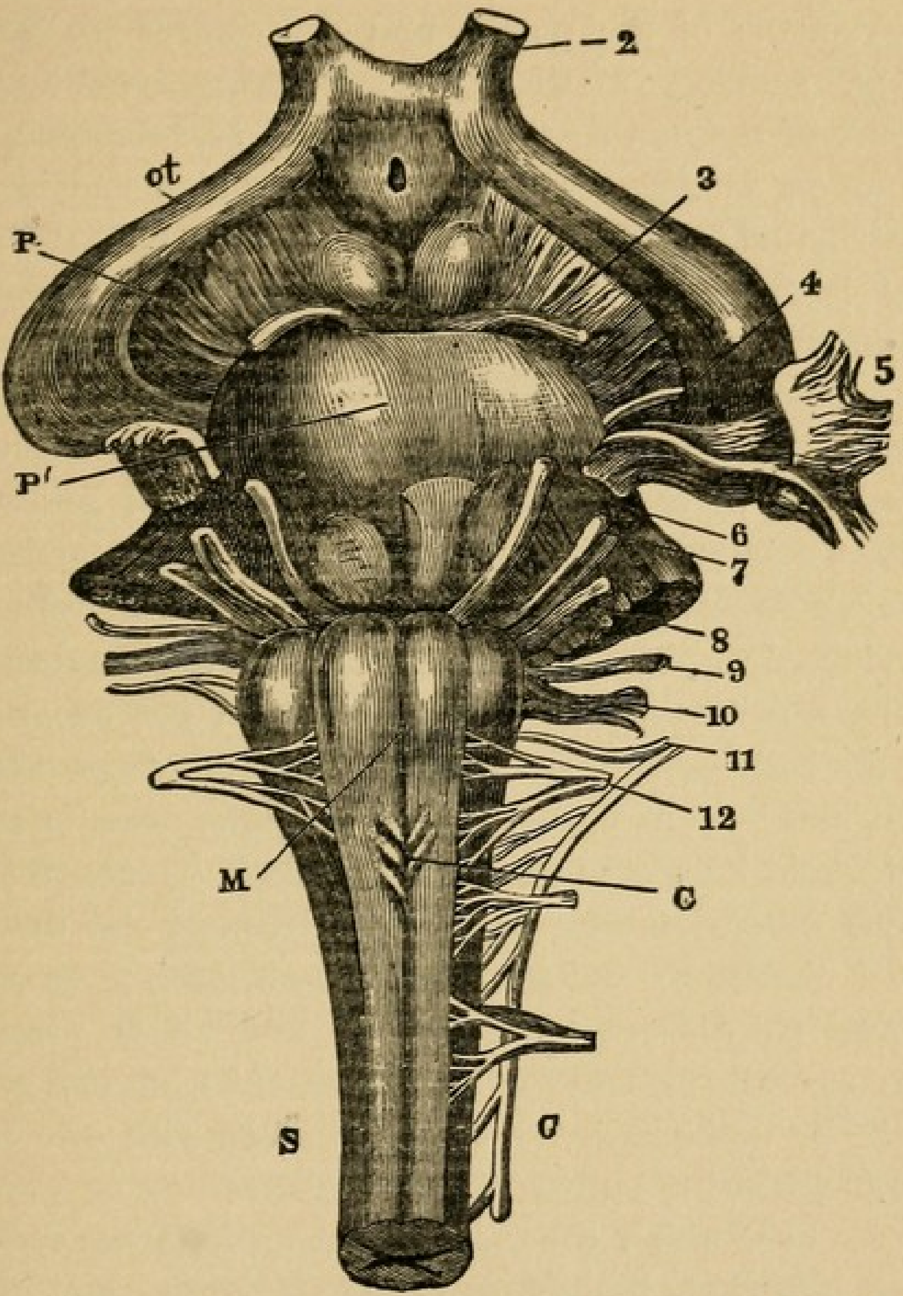
(1) Incoördination, as shown by unsteadiness and oscillation, a reeling gait, with tendency to fall either to the opposite side or backwards, and rotation fits; (2) rigidity of all four extremities, and increase of tendon reflexes on both sides; and finally, (3), general paresis, and deviation of the eyes, and nystagmus.

The recent work of André Thomas[122] on this subject gives an excellent *résumé* of cerebellar anatomy and physiology, but has not brought anything actually new.

IX.—The Medulla Oblongata (Bulb).

Physiologists are somewhat at variance at the present time concerning the mode of action of the nervous force in the medulla oblongata and its connections; for while some consider that the bulb contains a great number of definite and

FIG. 15.



Upper portion of the spinal cord, medulla, and base of the brain.

S C—Spinal cord, with nerves emerging from its side. C—Crossing of the fibres in the medulla. M—Medulla. P'—Pons. P—Peduncles of the brain. 2—Optic nerve. ot—Optic tracts. 3, 4, and 6—Nerves supplying the muscles of the eye, eyelid, and iris. 5—Nerve conferring sensibility on the face, taste on the anterior part of the tongue, and motive power on the muscles of mastication. 7—Nerve supplying the facial muscles. 8—Auditory nerve. 9—Nerve conferring taste on the posterior part of the tongue, and sensibility on the throat. 10—Pneumogastric nerve for the throat, windpipe, lungs, heart, and stomach. 11—Nerve for the muscles moving the head. 12—Nerve for the articulation of the tongue.

separate centres for the various automatic functions, such as respiration, the heart's action, salivary and sweat secretion, the movements of the pupils, and the centres for sneezing, coughing, sucking, masticating, swallowing, vomiting, etc., others are of opinion that these different centres must not be looked upon as masses of grey matter which can be anatomically isolated, or constitute separate organs; that they are called "centres" simply for the sake of convenience; that there are nerves supplying the respiratory, cardiac, and other actions connected with the bulb; and that these various parts require the integrity of the bulb and the nerves connecting them with it, in order that their several reflex actions may take place. Some years ago I[123] urged in a paper published in "Virchow's Archiv" that, while clinical medicine has frequently been indebted to physiological experiments for the decision of questions which come under our notice in practice, observation at the bedside may sometimes step in where physiologists disagree, and help to decide purely scientific questions by the light of clinical experience. It is indeed the observation of numerous clinical facts which has convinced me that there really are *thoroughly definite centres in the bulb*, possessing an anatomical substratum of their own, and all of which may suffer in encephalasthenia either separately from one another, bilaterally or unilaterally, or in conjunction with one or more of the neighbouring bulbar centres. According to the extent of the area over which the disturbance extends, the symptoms may thus be strictly limited, or varied and numerous.

All bulbar centres are in health in a state of moderate tonic excitement, but may suffer from either paresis or undue excitability, and thus show the characters of want of action or over-action. Symptoms of this character are often seen in persons with a neurotic inheritance, and in consequence of excesses in mental work, physical efforts, self-indulgence, etc.

1. *The cardiac centre* consists essentially of two parts, viz., the accelerator and the inhibitory centre, either of which may,

when affected with paresis or irritation, give rise to definite symptoms of disturbance.

Thus, unduly severe *palpitations* of the heart may be induced in asthenic persons by very slight causes, which would have no such effect in healthy people; and they may be so distressing as to cause the fear of impending death. The pulse is quick, small, and feeble, rarely of medium, and never of high, tension. In the cases under consideration there is no recognisable affection of the cardiac muscle or valves, or such disturbance of digestion, assimilation, the composition of the blood, etc., as might account for them; and we are, therefore, justified in ascribing them to undue excitability of the accelerator centre. This view is confirmed by the fact that treatment directed to this cause generally succeeds in dispelling the trouble.

Simple asthenia or *paresis* of the cardiac centres may occur in such persons without palpitations. The rate of pulsation may then be normal, but the pulse is of exceedingly low tension, feels like a thread, and is occasionally imperceptible. The patient may feel fairly comfortable when lying down, but is seized by vertigo and sick feelings in walking or standing. He is liable to attacks of faintness, which may cause him suddenly to fall down, but without losing consciousness, and to confusion of thoughts, arising from cerebral anæmia. Such symptoms may occur singly, or may be accompanied by polyuria, phosphaturia, exaggerated sensitiveness of the pupils to light, and similar signs, showing that a somewhat larger area in the bulb is affected.

Tachycardia is another analogous symptom, and may be owing to irritation of the accelerator, or more frequently to paresis of the inhibitory (pneumogastric) centre in the bulb. *Bradycardia*, on the contrary, arises from irritation of the pneumogastric centre; while arhythmia, or delirium cordis, points to complete anarchy of the combined cardiac centres.

2. The *respiratory centre* in the bulb may similarly suffer

from paresis or spasm. Some forms of spasmodic asthma and polypnœa are owing to these conditions, and may again exist by themselves, or in combination with other analogous symptoms.

3. The *vasomotor centre* may be considered in a state of spasm when the pulse is very small, the skin cold and pale, the face sallow, the fingers feel "dead," and the feet like ice. The patient appears anæmic, although the number of red blood-cells is normal. A sudden paroxysm of it may give rise to the *vasomotor form of angina pectoris*, which, however distressing at the time, is not nearly so serious as that form of it which is grafted on an organic base. Paresis of the same centre, on the other hand, leads to relaxation of the arterial walls, and causes reddening, especially of the face and neck, with increased heat. Sudden vasomotor paresis is the cause of *blushing*, which is such a common source of trouble and annoyance to those subject to it. The action of this centre is usually bilateral, but there may be paresis of one, and spasm of the other, half of it. One side of the face and other parts of the body is then red and congested, while the other is blanched.

4. The *pupillary centre* shows sometimes a condition of irritation by exaggerated sensitiveness of the pupil to light and accommodation (*hippus*); or it may be in a state of paresis, when the pupils are too large, and sluggish in their response to light. The disturbance may be bilateral or unilateral, leading in the latter case to inequality in the size of the pupils, which is, therefore, not always as ominous as it is believed to be by many observers.

5. The *sneezing* and *cough-centres* in the bulb must be held responsible for the spasmodic attacks of sneezing and coughing by which so many neurotics are troubled, and which are unconnected with any alterations of the nasal and other mucous membranes. If such affections are treated as catarrhal, they prove most rebellious to remedies, while they are apt to yield to nervine tonics.

6. The *sudorific* and *sweat-centre* may be in a state of spasm, leading to the condition known as *anidrosis*, where the skin is extremely dry, and does not even perspire under the influence of violent exertion. Paresis of this centre, on the other hand, is shown by unduly profuse perspiration, or *hyperidrosis*. The disturbance, again, may be bilateral or unilateral, so that one side of the body may be dry, and the other perspiring. *Paridrosis* is shown by changes in the quality of the perspiration. The sweat may be coloured, or contain blood or other substances, giving it an offensive odour.

7. The *salivary centre* is more apt to suffer from spasm than paresis. In the former case the mouth is uncomfortably dry, leading to thirst and repeated efforts at swallowing, without any palpable affection of the gastric mucous membrane or other parts. In paresis the opposite condition is noticed; the secretion of saliva being sometimes so profuse that it becomes a severe annoyance.

8. The *vomiting* or *gastro-intestinal centre* in the bulb is in its turn liable to spasm or paresis. Regurgitation of half-digested food, which by the patients is called *rumination*, is not uncommon in consequence of imperfect closure of the cardia during inspiration: and some forms of *irritative* and *atonic dyspepsia*, in which the reflex action of the muscular coat of the stomach is either exaggerated or greatly impaired, yet without any definite lesion of the viscus, come from time to time under our notice. *Dilatation of the stomach and intestines* is often of neurotic origin, and may yield to nervine remedies rather than to those which are credited with special influence on the mucous membrane of the viscus, or to very elaborate dietetic rules.

9. *The renal centre of the bulb* is perhaps more apt to suffer in encephalasthenia than any other. It is indeed rare to find a perfectly normal urine in the asthenic, the most common condition being low specific gravity, neutral or alkaline reaction, and phosphaturia. The excess of phosphates pro-

bably arises from undue combustion of the combined phosphorus of the brain in the form of protagon ($C^{66}H^{11}N^{2}P$) and lecithin ($C^{44}H^{96}NPO^{9}$). In some persons it only occurs after severe intellectual efforts, and is generally accompanied with mental depression, giddiness, and other symptoms of disturbed cerebral balance. It is of importance *as a diagnostic test*, as it is one of the few objective symptoms present in this neurosis, especially where there is a doubt about the reality of the patient's sufferings, which are often thought by his friends to be exaggerated or altogether invented. Phosphaturia may be complicated with functional glycosuria and albuminuria, showing that a somewhat larger area in the bulb is affected than when there is only phosphaturia.

A careful and prolonged observation of cases illustrating the various conditions which I have thus shortly described, can lead to no other conclusion than that there are definite centres of grey matter in different portions of the bulb, disturbance of which gives rise to definite characteristic symptoms, these being analogous to clinical signs which are encountered in the neurosis in question in the intellectual sphere, the speech area, the sensori-motor area, and the emotional centres in the mid-brain.

CHAPTER II.

THE CAUSES OF FAILURE OF BRAIN POWER.

An unstable nervous system transmitted from parent to offspring is the most powerful predisposing cause of this as well as of other neuroses. On inquiring into the family history of patients suffering from this malady, it is frequently found that parents or grand-parents, or uncles and aunts, have suffered either from the same affection, or from writer's cramp, spasmodic wry-neck, severe forms of neuralgia, hysteria, St. Vitus's dance, somnambulism, sick headache, spasmodic asthma, or undue excitability; that some of them have been in asylums, or committed suicide, or have been paralysed at a comparatively early age. The inheritance may, therefore, be special and direct, as in the case when sons and daughters inherit an unstable brain from their father or mother; or it may be general and indirect, as when a vulnerable nervous system, which in some ancestor has produced neuralgia or epilepsy, leads in a descendant to the symptoms which we associate with failure of brain power. In 681 cases of the latter affection which have been under my care, I have traced this influence in 299, that is, in 42·5 per cent.; but I am inclined to consider the percentage to be in reality much higher, as patients are often reticent about, and in other instances unacquainted with, such matters. At the same time cases unquestionably occur in which simple over-exertion of the brain will lead to failure of the power of the organ, where any neurotic inheritance can be absolutely excluded.

Hereditary tendency may act by itself in producing this neurosis, but it is more frequently aided by certain exciting causes, which latter are, however, in themselves habitually more or less insignificant, and would not have produced such effects unless the soil had been well prepared for the outbreak of the neurosis. As the influence of heredity in the production of such diseases is generally only lightly touched upon in the text-books, I think it proper to enter somewhat more fully into this important subject.

The Influence of Heredity.

According to Plato, hereditary honours are "a noble and splendid treasure to descendants," but the transmission of disease-germs from parent to offspring constitutes indeed a *damnosa hereditas*, that is, an inheritance entailing loss or misfortune. There is a large accumulation of facts showing that such inheritance exists, yet the mode of action of the laws which rule it, is at present very imperfectly known; and it appears probable that our views concerning them will soon have to undergo considerable modifications, for the controversy now going on between Haeckel, Weismann, Naegeli, de Vries, Boveri, Ziegler, Orth, Eimer, Virchow, Wallace, Galton, and others, cannot fail to lead to important results.

The only principle which is now generally admitted is, that all organisms have the power of transmitting their qualities and peculiarities to their descendants, inheritance being the rule, and non-inheritance the exception. But observers differ widely as to the manner in which this is effected. Until recently the generally received opinion was that the child, with all its mental and physical qualities and disposition, is formed through the influence of the spermatozoon on the ovum, the one giving the impetus to the development of the other. Indeed, Mercier[124] states that the sperm brings force and the germ brings matter, although he admits that this division of function is not absolute, inasmuch as sperm supplies some matter, and the germ contains a modicum of developmental energy. This theory of matter and force has, however, been rudely shaken by Weismann,[125] who assumes the existence of a "germinal plasm" as the carrier of heredity, and locates it in the chromatic substance of the nucleus of the cell. According to him there are excessively small units in the chromatine of the nucleus, which are organised and capable of propagation.

Biophores.

These "life-carriers," or biophores, are composed of a number of molecules, and differ by their arrangement, corresponding to the peculiar kind of cells of the parental organism. Allied biophores, which belong to a group of tissues, form larger units which are called *determinants*, and these unite again to form still larger units, which are called *ides*; and the development of the fœtus proceeds under the influence of these dissolving sets of biophores. Dissolution of germinal plasm, however, does not go on in all the cells, for in a certain series of them the plasm remains at first inactive, although it keeps constantly increasing in bulk: and from these cells there occurs a continuous transference of matter to the general cells of the fœtus. This would explain why the descendants resemble their parents in the principal points; indeed, they would do so altogether unless the fœtus were subject to certain disturbing nutritional influences on the part of the parental body. The most active factor, however, is the union of the paternal and maternal germinal cells, which Weismann has called *amphimixis*, and in which either an equal mixture of both parental characters, or a preponderance of the paternal or maternal peculiarity, is the result. Sexual propagation is, therefore, according to Weismann, owing to the alteration of the germinal plasm by the union of the two sets of germinal cells, and not to the influence of the spermatozoon on the ovum.

Another theory is that of Naegeli, who calls the substance which carries heredity "idioplasm," and assigns it to the protoplasm, as well as to the nucleus of the cell; while Haeckel[126] contends that the protoplasm plays the active part in what he calls progressive or acquired transmission, and that the nucleus controls conservative transmission. Anyhow, we may assume that variations of the germinal plasm, caused partly by amphimixis and partly by nutritional influences acting upon the germinal cells, form the base of natural selection; and that where the two sets of germinal cells are unsuitable to each other, or where either of them is defective, imperfect development of the offspring will be the result. This imperfection will, as a matter of course, show itself chiefly in the most complex and elaborate faculties, viz., those of the centres of the nervous system.

Inherited and Acquired Transmission.

Proceeding further, we find a wide divergence of opinion as to the question whether inherited and acquired qualities, or only the former, can be transferred to the descendants. Haeckel[126] distinguishes between the transmission of inherited characters, or conservative transmission, and the transmission of acquired characters, or progressive transmission. Weismann,[125] on the other hand, denies that there is any transmission of acquired characters at all, and contends that, where such is apparently the case, such characters only first appeared in the parents, but had previously been latent in the germinal matter from which they were themselves developed, and not been acquired by them during their own individual life through the influence of such external circumstances as climate, nourishment, education, etc. Wallace maintains that everything which has been imputed to the hereditary influences of acquired character is either the result of imitation by children or the transmission of inherent idiosyncrasies received from some ancestor. Virchow, Romanes, and Hansemann do not accept Weismann's and Wallace's contention, which appears, indeed, to be contradicted by the common experience of life. Take, for instance, the case of a woman who has become a drunkard in consequence of accidental circumstances, such as medical prescription of alcohol during acute disease, overpowering grief, or other causes. Will she not, if pregnancy should result after this habit has become established, be more likely to give birth to degenerate offspring than if she had never committed alcoholic excesses? Or take the case of a father who has in childhood, through the example of others, been led to practise masturbation, and who has later in life acquired syphilis; can he be expected to procreate children as sound as any he might have had if neither of those two accidental circumstances had happened? Again, a child conceived during temporary enfeeblement of either of the parents, as during convalescence from typhoid fever or other exhausting illnesses, has often been found to have a permanently feeble constitution engrafted upon it.

Laws of Inheritance.

The principal laws of inheritance, as formulated by Darwin, Haeckel, Wallace, and others, are as follows:—In conservative inheritance the most generally active law is that of *uninterrupted transmission*, so that the parents are as like the grandparents as they are like the children. The action of this law is, however, modified by a second law of *interrupted or latent transmission*, which is more generally active amongst the lower animals and plants than amongst men; yet it is not unfrequently seen in the latter, where a child may resemble his grandfather or grandmother, or even more remote ancestors, much more than his father or mother. Not only the features, the colour of the hair, the size of the body, but also the temperament, energy, talents, diseases, and habits of remote ancestors may thus be transmitted. In some of the lower animals quite a number of generations are habitually leapt over, and we thus arrive at the phenomena of *reversion* or *atavism*, where individual animals or men assume a form which has not existed for a few or even many generations, and belongs to a generation which has long since disappeared. In the intervening generations, therefore, such a quality was latent; it was, as Darwin says, written in invisible ink, ready to appear on the proper test being applied. Such a test may be the union of a person in whom it is latent with another in whom it is patent. Weismann considers that in the process of development there may be no change in some parts of the germinal cells, more or less numerous "determinants" remaining unaltered, and being deprived of influence on account of their small bulk; but that under favourable circumstances, as for instance, where each of the two different germinal cells possesses such "determinants," a character which has long disappeared may come to light again. The longer the time which has elapsed since such a peculiarity has been lost, the more improbable, however, is its reappearance.

A third law of conservative transmission is that of *sexual transmission*, according to which each sex transmits to the descendants of the same sex peculiarities which are not inherited by the descendants of the other sex; and these need not be connected with the sexual organs, such, for instance, as the beard in man, or the spur in the cock, etc. Thus, for instance, the hæmorrhagic diathesis habitually runs in the male line, sparing the daughters, and the mental qualities, as well as tendency to neurotic disturbance, may be inherited only by sons from the father, and by daughters from the mother. This law is, however, often modified by the fourth law of *mixed* or *mutual* or *amphigonous transmission*, according to which every child receives qualities from the father as well as from the mother. The male children may then either resemble the father, and the female children the mother; or there may be *crossed inheritance*, so that a son resembles the mother, and the daughter the father. In addition to this there may be, as Mercier[124] has pointed out, the following possibilities:—1st, The offspring may inherit the qualities of either parent solely; 2nd, it may inherit the qualities of one parent in some respects, and those of the other parent in other respects; and, 3rd, it may inherit the father's attributes at one time of life, and the mother's at another. The power of one of the parents to impress upon the offspring the features of his or her own organisation to the exclusion of the distinctive qualities of the other parent is called *prepotency*. If one of the parents possesses a normal, and the other an unstable brain, the contest for preponderance in the offspring will be decided by the length of time during, as well as by the vigour with, which the stability or instability of the germinal plasm may have been transmitted.

A fifth law, which Haeckel has placed under the heading of acquired transmission, but which appears to me to fall more suitably under that of conservative inheritance, is that of *contemporaneous* or *homochronous* transmission, or, according to Darwin, the transmission at *corresponding periods of life*. Thus certain diseases may appear in the system of the child at the time corresponding with that in which the parental organism contracted the same disease. I have known a family in which every son, but none of the daughters, became insane about the age of 25 years. Esquirol has mentioned a family in which the grandfather, father, and son committed suicide about their fiftieth year; and in another family blindness from retinitis pigmentosa appeared in three generations, twenty-seven children and grandchildren having been affected by it about the same age. With the aid of this law we may not unfrequently account for the outbreak of a nervous disorder, which seems to come on without any apparent cause, by the fact of its appearance at a certain time of life. With this law there is very closely connected the sixth law of *homotopic transmission*, according to which peculiarities are transmitted in corresponding parts of the body (moles, warts, etc.).

Progressive or acquired transmission by inheritance, which, as we have just seen, is denied by Weismann and Galton, is strongly supported by Haeckel, who contends that the organism may transmit to its descendants, apart from inherited qualities, likewise those which it has acquired from its individual surroundings during its own lifetime, so that inheritance becomes here mixed with adaptation. The first law of progressive transmission is, according to Haeckel, that of *adapted transmission*, which is shown chiefly when the newly-acquired peculiarity produces a considerable change in the inherited form. Examples of this are transmission of six fingers and six toes to the succeeding generation, or of consumption, insanity, albinism, etc. Even mutilations caused by accidents may be thus transmitted. This latter point is, however, contested by Weismann. Zacharias exhibited before the Natural Science Congress at Wiesbaden, tailless cats, whose mother was stated to have lost its tail years ago by injury. Further inquiry, however, showed that the history of that injury was not well authenticated, besides which it is known that cats are occasionally born tailless, without the parents having shown a similar peculiarity. An irregularity of this kind, which has occurred in consequence of a certain condition of the germinal plasm, might therefore be transmitted by conservative, and not by acquired inheritance. Yet Wallace has recently been obliged to confess that there is such a thing as pre-natal influence, showing that a child may, apart from hereditary tendencies, be affected by external influences acting upon the mother when pregnant, and has brought the following case before the British Association :—A gamekeeper met with an accident, which obliged him to have his right arm cut off. His wife being unable to nurse him after the operation, another married woman undertook the duty. Six months afterwards she gave birth to a child, whose right arm was only a stump. It presented exactly the same appearance as that of the gamekeeper's. There was nothing whatever in the families of either the father or the mother of this child to warrant the conclusion that the deformity arose from hereditary causes. Wallace accepts this case as an authentic proof of pre-natal influence; and this seems to me the first step towards his conversion to the theory of acquired inheritance.

The second law of progressive inheritance is that of established or *habitual transmission*, in consequence of which qualities acquired by an organism during its individual life are more certainly transmitted to the descendants in proportion to the length of time during which the causes of these changes have been in action, so that the longer a newly-acquired quality has been transmitted, the more certainly will it be preserved in future generations. From this it results that the longer consumption, insanity, or cancer may have been hereditary in a family, the deeper will be the root of the evil, and the more probable it is that all succeeding generations will be marked by it.

With regard to the inheritance of diseases, Weismann and Baumgarten consider that it is only apparent, as it is not the morbid condition itself which is transmitted, but only its cause in the shape of bacteria. Thus syphilis, epilepsy as artificially induced in guinea-pigs, and tuberculosis, may be transmitted. The tubercle-bacillus may exist in the spermatozoon as well as in the ovum in a condition of latency, and develop as soon as circumstances may be favourable for it. This view seems to me to stretch bacteriology to its utmost limits or even beyond them, for there are many other causes of disease besides bacteria.

It appears to me impossible to contest the existence of these different laws, although we cannot at present explain the molecular processes which take place in consequence of them; but the theories of pangenesis (Darwin), perigenesis (Haeckel), idioplasm (Naegeli), germplasm (Weismann), and intracellular pangenesis (de Vries), which have been lately proposed, must be looked upon as merely provisional, since they cannot be proved by microscopic observation, or by physical and chemical experiment. Much, however, may be done towards the establishment of a truly acceptable theory of hereditary transmission by more accurate observation of the influence of heredity in the production of disease, for we want facts rather than theoretical considerations regarding these important points.

The fact that genius is rarely, if ever, transmitted by inheritance, has by Cajal[126] been attributed to the circumstance that the higher organisation of the brain is the result of personal adaptation, and therefore not well transmissible by inheritance. This indeed seems to explain why men of genius rarely have clever children. Napoleon's and Goethe's progeny was of the most ordinary kind; and in England neither the great Duke of Wellington nor Mr. Gladstone appear to have transmitted their genius to their children. This is a point making for Weismann's theory, that acquired qualities are not transmitted. On the other hand, special aptitudes or talents may be transmitted, although even this is rare. Amongst musical composers, for instance, the only case I am acquainted with is that of three generations of the Strauss family, equally gifted; while Handel, Haydn, Mozart, Beethoven, and Richard Wagner, remained unique and isolated specimens. In the higher ranks of the medical profession in England we have only a few exceptional cases, where the son occupied an equally distinguished position as the father; although in general practice three succeeding generations of very able men do not appear to have been quite so uncommon. That the transmission of talents should on the whole be rare, and that the son should only seldom reach the intellectual or artistic level of his father, is probably owing to the circumstance that the influence of the mother may run in the contrary direction, since she may possess a more imperfect cerebral organisation, and her hereditary qualities may, therefore, clash with the paternal impulse towards progressive development. Another reason may be that, while the son is growing up, there may be an absence of those favourable conditions of moral and intellectual environment, which modelled and perfected the brain of the father. This consideration seems to explain why a very eminent man has generally had a mother who was a most excellent and superior woman. In the cases of Napoleon and Goethe, which I have already quoted, this circumstance has been of undoubted influence.

Inherited talents appear to cease anyhow in two or three generations, because men often marry for beauty, money, or social position, instead of for high intellectual qualities in a wife. In this way everything is gradually levelled or deteriorated, and the development of highly organised brains prevented. Thus an Athenian of the time of Pericles had probably his association-centres equally well-developed as an inhabitant of modern Paris or London; and a consecutive improvement in the quality and quantity of the brain-cells, with their axones and dendrites, has not taken place in history.

Cajal laments the circumstance that the vertebrates seem to be a type of a definitely closed organisation. From fishes to men there have been variations in accidentals, but not in the essence of construction; and with the human organism Nature seems to have exhausted everything that could be obtained for physiological adaptation and perfection of structure within the mechanism of the vertebrate. As long as we are devoid of a sense which allows us to have direct communication with matter, no progress can be made in such vast and at present insoluble problems as the origin of life, the nature of matter and force, etc., even if all phenomena which are accessible to our senses, aided by the most delicate instruments, should be registered, compared, and classified. If there is to be real progress it is necessary to assume that life has not yet exhausted its types; that the albuminoids and physiological properties of the brain-cell may become subservient to far higher combinations of laws than exist in the meagre and scanty structure of the *Homo sapiens*, and that at some far distant time a *supra-vertebrate* may eventually be formed. Such an organism, supreme in its development, gifted with exceedingly differentiated and sensitive instruments of perception and ideation, may perhaps finally penetrate into the real mechanism of the Universe, and may succeed in solving problems which disturb and agitate in vain the present vertebrate man.

Inheritance of Disease.

It is to be regretted that the influence of heredity can never be accurately known in the bulk of mankind, as most people do not care about what may have happened to their more remote ancestors, or if they do, would be unable to find it out. To trace such influences is only possible in the history of royal and noble families; and Ireland[96] has therefore done good work in giving us the neurotic history of the Russian and Spanish dynasties. The story is a truly ghastly one, and should induce the royal families of Europe to abstain from intermarrying with those tainted with insanity and other neuroses, and rather to seek morganatic marriages, which are now considered to disqualify for succession, in order to improve their germinal plasm.

Some Princely Families.

As Ireland has only spoken of the history of the Russian and Spanish dynasties, I think it worth while to give a few notes on the neurotic history of some other princely houses during the present century with which I happen to be acquainted, showing the "debasing effects of unchecked power," and of frequent close intermarriages with families of the same stock.

A prince, who had had a stupid father and a clever mother, was generally considered inoffensive and good-natured, but was addicted to drinking, and had had several severe attacks of delirium tremens. When such an attack was over, the Court Physician assembled the whole family and household, including every menial, and in their presence gave a terrible lecture to the prince, drawing his attention forcibly to the degrading effects of drink, more especially in a person so highly placed. The prince, with tears in his eyes, promised amendment, but relapsed soon afterwards. His only brother was a furious dipsomaniac, and died of general paralysis. The prince was succeeded by his eldest son, who was then, although a comparatively young man, suffering from paralysis agitans, of which he eventually died. On his accession he found his country admirably administered by a set of permanent officials of ability and rectitude; but as these men were unwilling to obey his whims when illegal, he called into his council as Prime Minister a person of evil reputation, who, although otherwise insignificant, had succeeded in making his name a by-word throughout the country. This man, whose ignorance of all the details of administration was only equalled by his supineness to the caprices of his master, succeeded in a short time in bringing the whole machinery of the government of the State into the utmost confusion and contempt. The country was rescued from this unprincipled adventurer by a mere accident. He went on a visit into a neighbouring State, where the sovereign caused him to be imprisoned on a charge of larceny, to the intense delight of the public. His own prince at first attempted to rescue and shelter the minister, but received a significant hint from a stronger power that it would be best to have done with the person in question; and he reluctantly acquiesced in this. A younger brother of the same prince was known to entertain the grandest delusions with regard to his status "by the grace of God," and to act accordingly. Another brother took to gambling, fast living, and borrowing money wherever he could get it, and died comparatively young. A third brother was a harmless idiot.

Another potentate of the present century had the delusion that, as he was instituted "by the grace of God," he could do no wrong; and he was credibly reported to have committed every crime known to the code. It was stated that, if one of his subjects had acted similarly to him, "he would have been hung half a dozen times over." The son of this prince was eaten up with similar delusions of grandeur. He was entirely under the influence of his barber, and did his best to punish his subjects as much as he possibly could, more especially when there had been "bad elections" to the Chamber.

Another prince stated publicly that "man commenced with the baron," and that all persons beneath the rank of a baron were only so much cattle.

Another potentate, fortunately the last of his race, found an insane delight in worrying and spiting any of his subjects with whom he happened to come in contact. Almost incredible stories are told to this day of his truly diabolical ingenuity in this respect. He was eventually dispossessed by a stronger power, and when expelled from his country, did not leave a single friend behind him, but was followed by the execration of his former subjects.

The last two reigning dukes of an historic lineage, and coming from an originally powerful stock, were notoriously deranged, and one of them made himself the laughing-stock of Europe by his crazy behaviour. Their line is now extinct.

I could easily multiply similar instances tending to confirm Ireland's conclusion that "a race sodden with epilepsy, insanity and scrofula, whatever its fictitious rank, is necessarily low-born, and is not worth preserving," intermarriages between such persons being "fraught with great dangers, not only to the family, but to the nation placed under its rule, and which must suffer for the extravagances of its members."

Heredity in less Exalted Persons.

I now proceed to illustrate the influence of heredity in failure of brain power by some cases which have recently fallen under my observation.

A single lady, aged 27, who consulted me for symptoms of that affection, gave me the following history:—Her maternal grandmother had been in an asylum for many years; her own mother had always been eccentric, so that, for instance, she refused to go to bed when other people retired to rest, but stayed up all night, and went to bed at 8 a.m. The mother's sister had been in an asylum; the mother's brother had been two years under restraint, but was now discharged, and suffering from scrivener's palsy. Another maternal aunt had four times had puerperal insanity, and was habitually extremely ill-tempered. All these persons on the mother's side had begun to suffer about the same time of life, viz., between 23 and 26 years of age. Finally, her father was then suffering from general paralysis. A truly "damnosa hereditas!" Yet she kept in fairly good nervous health until about three years ago, when an exciting cause supervened which upset her nervous balance. She paid a visit to America, met with boisterous weather in the Atlantic, and was sea-sick during the whole of the voyage. She eventually vomited blood, and had profuse bleeding from the right nostril. Ever since then she had suffered in a variety of ways from failure of brain power. Her memory was impaired, she often felt muddled and confused, could not finish her sentences when speaking, and was apt to repeat the same words several times over when writing a letter. She was often restless at night, and had during the day the greatest trouble to keep herself in hand. Society irritated her, and she often felt impelled to be rude to people without any apparent cause. She always had a weight on her mind, was troubled with the recollection of unfortunate things which belonged to a dead past, yet could not prevent her thoughts from constantly dwelling upon them. She was also subject to pressure and weight on the head, had great difficulty in giving her attention to any subject, however important, and occasionally hardly knew what she was saying.

Cranial percussion showed great tenderness, and the deep reflexes were exaggerated. It is impossible to conceive that the accidental occurrence of sea-sickness alone should have given rise to such a variety of symptoms unless the soil had been fully prepared for the outbreak of the neurosis. I have more recently seen a case of delusional insanity brought on by prolonged sea-sickness; but in that case there was likewise abundant predisposition by inheritance.

The case just related may be seen to illustrate four different laws of inheritance, viz., 1st. The law of uninterrupted transmission, from parents to offspring, as both her father and mother were neurotic; 2nd. The law of mixed or amphigonous transmission, as she received bad qualities from her father as well as her mother; 3rd. The law of sexual transmission, as the inheritance was much greater on the mother's than on the father's side; and finally, 4th. The law of contemporaneous inheritance, or transmission at corresponding periods of life, for she began to suffer at a time of life which had been ominous to her relations. The progress of the case has been satisfactory, as neither insanity nor coarse disease of the brain has become developed, and the symptoms of failure of brain power have gradually vanished; yet with such an inheritance the ultimate prospects of the patient appear to be very doubtful, more especially if future events in her life should be of a distressing character.

Some years ago I was consulted by a gentleman, aged 35, married, who had been ill for the last six years. He attributed his illness to overwork and anxiety in business; but his family history was also unsatisfactory. His father had committed suicide, after having for years suffered from nervous troubles, and his mother was extremely nervous and of a worrying disposition. His habits had been fairly steady; he had never gone in for debauchery, masturbation, drinking, or excessive smoking; he had had gonorrhœal rheumatism, but no syphilis, and no other disease. He complained, however, very much of distressing sensations about the head, such as heat, throbbing, smarting, fulness, and pressure on the sides and the back of the head. He had also constant tingling and spongy feelings in the spine, and throbbing in the hands and body, especially at night. From time to time he suffered from singing in the ears, and giddiness, and always from depression of spirits. These symptoms were made worse by anxiety in business, bad news, letter writing, talking, hot rooms, long walks or drives, and by playing billiards and indulging in wine and tobacco. Very slight intellectual exertion sufficed to render him utterly exhausted. He had lately been much upset by a quack having told him that he had "a growth in his brain." I examined him carefully, and found no trace of organic disease. The reflexes were normal, and the muscular power good (140° right, and 120° left hand). The urine, however, was neutral, and contained an excess of phosphates. A satisfactory recovery from all these troubles confirmed the diagnosis, but relapses have since then occurred, which were, however, slight in character, and rapidly yielded to treatment; on the whole this patient has now been wonderfully well for the last ten years.

Another case was that of a young lady, aged 20, whose mother had always been extremely nervous, and whose father had been a "fast liver." I was informed that her mother had suffered through her husband's bad conduct at the time this girl was born. There were, however, no stigmata of inherited syphilis in the patient, who had been out of health for several years when she first came to see me. She had an almost incessant frontal headache, a bad memory, giddy and drowsy feelings, and extreme mental depression. She thought that every one was against her, and never seemed to get on with any one. Slight physical and mental efforts produced a disproportionate feeling of exhaustion. She had the greatest difficulty in fixing her attention on a subject, in reading a book, or composing a letter; yet, as she looked well, and there were no symptoms of coarse disease, no one believed in her ailments, and she found no sympathy for her wretched condition.

A gentleman, aged 42, who was a martyr to irritable testicle, informed me that he came from a highly neurotic stock. His grandmother had been unduly excitable all her life; his mother was often not responsible for her actions; a sister had been several times in an asylum, and suffered from dipsomania: another sister and four brothers were highly nervous; and his father, who was then 72 years of age, had generally been quite well, but had just made a very unsuitable second marriage with quite a young woman. This case illustrates, amongst others, the law of *crossed inheritance*, as the patient had evidently derived his neurotic condition more from his mother's than from his father's side.

An architect, 58, married, and father of seven children, was heavily burdened. His father died quite young of overwork and consumption; his mother had always been nearly imbecile; a sister was in an asylum for refusal of food and melancholia; one brother drank himself to death, and another died of overwork, together with alcoholic excesses. He complained of an empty feeling in the head; his memory was impaired; he was undecided, inclined to consult others constantly, utterly fagged in the evening, and would lie awake for hours without sleep. He always felt chilly, had lost power over the lower limbs, had an aching in the back, and coldness and numbness in the feet. There was also a deep feeling of illness, great pulsation of the abdominal aorta, enormous exaggeration of the knee-jerk, and great tendency to diarrhœa on the slightest occasion.

A tradesman, aged 30, married, stated that his father had for some time past been imbecile, and his mother nearly so. He had, nevertheless, on the whole enjoyed good health, with the exception of an attack of rheumatic fever eleven years ago, which had left disease of the aortic valves. This, however, gave him no trouble, compensation having been effected in a very satisfactory manner by hypertrophy of the muscular wall of the left ventricle. He was a hardworking man, temperate, and of steady habits. The illness for which he consulted me began quite suddenly nine months ago without any apparent cause, with a peculiar rushing or stirring sensation in his head, which seemed nearly to paralyse him. This feeling had continued more or less ever since, and had prevented him from attending to his work, as well as caused extreme depression of spirits. He had consulted several doctors, who told him that it was "nothing," and that he must rouse himself and shake it off; but this, unfortunately for him, he found utterly impossible to accomplish, for, however much he had battled against it, the influence of this trouble was simply overpowering.

On examination I found great tenderness on the cranium and the upper portion of the spine, which he could not bear to be touched, but no other objective symptoms on the part of the brain. He stated that when the feelings in his head were particularly bad, he was obliged to rush out of the room, just anywhere, and lost all self-control. A few applications of electricity to the mid-brain removed these sensations, and the patient was able to resume his occupation. Twelve months afterwards I was informed that he had continued perfectly well.

Imperative Words and Ideas.

In the following case the principal trouble was a compulsory idea:—

A young gentleman, aged 22, had been delicate from birth.

His father died of paralysis when young; his mother had all her life been subject to attacks of violent excitement, and was now in an asylum. The patient slept with his mother until he was ten years old, and after that had been constantly with her when she was violent, until she was placed under restraint. He was subject to headaches and occasional attacks of giddiness; but what troubled him chiefly was that certain words turned up in his mind from time to time, and compelled him to think constantly of them, to the exclusion of other things. These words were not always the same; during the last few days the word "cast-iron" had been supreme. The patient had a peculiar tic about his face, more especially the forehead. The intellectual force appeared to be below the usual standard, but the patient had an amiable character, and his behaviour had always been proper.

A clerk, aged 45, single, had always been of an over-anxious temperament, and inclined to think that things were going wrong. His father had been a healthy man, and died of bronchitis; but his mother was very shy and nervous, and could rarely be prevailed upon to leave her home. As a boy he showed great lack of confidence, and was doubtful of himself. His habits had always been temperate. The principal trouble which made his life a burden to him was connected with a register which he had to keep at his office; and he was haunted by the fear that he had made false entries, or that the book had been tampered with. The word "register" constantly came into his head, and he could not get rid of it. When he lately had a holiday at the seaside "he kept walking and worrying all day long about that register.' Another source of trouble to him was that, being in the habit of putting two dots under his signature, he would, after sending off a letter, worry himself whether he had only put the dots or anything else there. This often seemed to give him sleepless nights. His brother had been drowned at sea seven years ago, and this made a great impression upon him. When looking at his bath in the morning he thought he saw his brother in the water. He said that his trouble was so great that, if he were not such a coward, he would make away with himself. Everything appeared black to him, and he was convinced that he would have to starve some day, as he had no money. A letter which he on one occasion addressed to a fellow-clerk made him unhappy for two years. Sometimes he kept walking about in his bedroom all night; he had no control over these wretched feelings, although he knew that it was ridiculous to have them. While rather on the borderland, this man was certainly not insane, for his judgment was good, his reasoning powers, apart from the imperative ideas mentioned, were normal, and he did his work most punctually and to the satisfaction of his employers.

Agoraphobia.

A merchant, aged 49, single, who had lived chiefly in the tropics, had led an exciting life, being equally fond of politics, business, and pleasure. The whole of his family was nervous. His father had died of apoplexy; a brother was extremely irritable, and most unreasonably jealous of his wife, who had never given him the slightest cause for that feeling, which was so intense that he had threatened to murder first his wife, who was a high-minded and virtuous lady, then her supposed paramour, and finally to make away with himself. A sister and niece had suffered from epileptic seizures. The patient complained of what he called a peculiar kind of "fits," which overtook him as soon as he went out of doors. He seemed to stand as it were transfixed, unable to walk or to hold himself up properly, and expressed by pantomime the state in which he was, thus calling for support. When he felt himself supported by another man's arm he gradually recovered himself, and was then able to go on and walk for a considerable distance. He could not sit out of doors without supporting his head with his hands. He never lost consciousness in such an attack, and always knew where he was, but he could not take in what happened in the street, or take notice of more than one thing at a time. He was very excitable, and the least contradiction annoyed him. His memory was somewhat impaired, and his head altogether not quite what it used to be; he had sometimes a difficulty of expressing himself, and was apt to substitute one word for another. The tongue was pale, the pulse feeble (112), the urine and the reflexes normal, and the muscular force rather feeble. He always felt cold and chilly. There was no limitation of the field of vision, except in attacks. The case was therefore one of agoraphobia, produced through inherited neurotic tendency.

Other Morbid Fears.

A merchant, aged 37, married, had for some time past been out of health without any very definite symptoms, when one day just as he was sitting down to dinner, and taking up a carving-knife, the idea came into his head that he must cut his throat. At the same time he felt a great rush of heat rising from the stomach and going to the head. He managed to control himself, but since then ideas of suicide and homicide, which he would be compelled to commit, rarely left him. With this there was great restlessness and excitement, especially when he was at home. On one occasion when travelling by train he had to rush out of it before it stopped, because he could not stand it any longer. His power of application was bad; he could not fix his attention, and suffered from extreme depression of spirits. He slept badly, and when in bed had a sensation as if he were falling through the bedstead. His appetite was capricious, and the bowels sluggish. Both his parents had died young; his father had led a fast life; one brother had died of consumption, and the other, when 23 years old, killed himself by jumping out of a second-floor window. He improved by treatment so much that he considered himself well, when about eighteen months afterwards symptoms of spinal debility made their appearance. He had great pain and weakness in the back, especially about the loins and in the testicles, numbness, and pins and needles in the legs, difficulty in walking for any length of time, and utter want of staying power. Even in sitting he felt as if he were falling, and could not sit upright. The knee-jerk was very sluggish on both sides, chiefly the left. With this there was great throbbing in the pit of the stomach, with flushes of heat in the face. The tongue was red and irritable, the bowels irregular, the sexual function weak, and the urine habitually charged with lithates and phosphates. He recovered from these troubles in about a month, and progressed favourably for some time, when he was again taken with a different set of symptoms, viz., severe pain in the pit of the stomach, above the navel, which was so agonising that he thought an abscess or a tumour must be forming there. Afterwards he had such palpitations "as if everything was going to burst"; and he habitually felt faint and nervous. There were, however, no objective symptoms of importance, and he gradually was relieved of all these troubles, and continued afterwards in fairly good health.

The history of inheritance in this case is very defective, yet the circumstance that both parents died young, that the father may have had syphilis, that one brother committed suicide and another died of consumption, are most significant. Amongst the several diatheses, I have found the tubercular to be next in importance to the neurotic in causing predisposition to various affections of the nervous system.

An *advanced age* of either of the parents, and *disparity of age* between the two parents, may predispose the offspring of the marriage to failure of brain power.

Kleptophobia.

A solicitor, aged 29, consulted me for a peculiar form of this disorder from which he had suffered for about two years and a half. He feared that he would be compelled to steal something, to pick somebody's pocket, or to strike somebody without provocation. This fear had become quite a burden to his life, and he wished to take every precaution in case he might commit himself, as he knew of cases where the desire to steal had been carried out, and the family of the person in question had been put to heavy expense and annoyance. In other respects he was quite well, and able to attend to his professional duties. If I felt inclined to coin new words, I should call this case one of kleptophobia, as distinguished from kleptomania. No exciting cause was to be discovered, but on inquiry into his family history, I found that his father had been an aged man at the time the patient was born, and had had the reputation of being nervous and peculiar, while his mother, who had been much younger than his father, had died of advanced phthisis shortly after the birth of the patient. There was therefore disparity in the age of the parents, advanced age and eccentricity of the father, and consumption in the mother, all tending to predispose the offspring to neurotic troubles.

Other factors in parents which may lead to this neurosis in children are alcoholism, gout, and severe rheumatism. The relations more especially of gout to nervous affections are so intimate that gout has recently been asserted to be a neurosis. This appears to me to go too far, and I am more inclined to side with Charcot's view, who considers that the arthritic condition may be likened to a tree, the principal branches of which are gout, articular rheumatism, some forms of sick headache and certain cutaneous diseases, while on the other hand there is a nervous tree, comprising hysteria and a variety of other hereditary nervous affections. These two trees live as it were on the same soil; they communicate with each other by their roots, and have thus the most intimate relations with one another without being absolutely identical.

On the other hand, it would be a mistake to assume that descent from a neurotic parent or ancestor will invariably lead to encephalasthenia. Many persons escape such influences altogether, just as those who come from epileptic or hysterical parents may never show a trace of these disorders. The influence of inheritance is therefore not absolute.

Influence of Race.

The prevalence of failure of brain power in *Jews* I am inclined to attribute chiefly to the prejudicial influence which centuries of relentless persecution have exerted upon the nervous system of that race. Jews are, for the same reason, greatly predisposed to epilepsy, chorea, and analogous nervous affections. The Slavonic races are more liable to the neurosis than the Teutonic and Anglo-Saxon nations; while Americans furnish a still larger contingent, in consequence of living in an incessant state of restless excitement, and with a total disregard of hygienic rules. In Jews another influence would appear to be that they intermarry too much, and this leads us to the consideration of

Marriages of Consanguinity.

It is generally admitted that for the production of normal offspring a certain degree of kinship is required, but there must also be well-marked differences between the male and female germinal cells. When the kinship is too close, the constitutional faults on both sides are liable to become exaggerated. Deterioration both of physical and mental qualities will follow, and the nervous system will become so vulnerable as to succumb easily to slight unfavourable influences. For this reason marriages of first cousins are to be avoided, even if there is no direct inherited nervous deficiency in parents or grandparents; for the laws of interrupted or latent inheritance, and of reversion and atavism may step in, and predispose the offspring of such marriages to nervous diseases which may not have existed for several generations. Of course, the objectionable character of unions of this kind becomes more glaring where neurotic predisposition is apparent. Cross-bred plants and animals grow more rapidly, mature more early, and become more highly developed than pure-bred plants and animals. The diversity, on the other hand, must not be too striking, as otherwise greater liability to disorder will result, for too rapid growth and development, such as we see it in precocious children, is more frequently followed by eventual disorder than where growth and development proceed at a more moderate pace. Those who are interested in this question will find a mine of information in Huth's[127] work, and in the writings of Langdon Down,[128] Sedgwick,[129] and Shuttleworth.[130]

A clerk, aged 21, informed me that his father and mother were first cousins. His father had been sound, but his mother was nervous, and apt to worry over trifles. A maternal uncle had long suffered from delusions, and died of "softening of the brain" (general paralysis). When quite a child, the patient had been unusually timid, had constantly had frightful dreams all night, and had suffered from obstinate constipation. He had always had a difficulty in learning his lessons, and if he took extra trouble about them he had nasty feelings in the head and all over; his "mind had always been over-focussed and too self-conscious." He had now a difficulty in adding up figures, had disinclination for work, a flight of ideas; he had crawling sensations over the forehead, creepy feelings in the spine, pricking all over the face and body, and could not sweat. There was often throbbing in the head, and he became very depressed when doing anything very long. In thinking or writing he often lost the thread, could not make his meaning understood by others, and sometimes got into serious difficulties in consequence. The knowledge that this might happen again would often throw the mind back on itself, and cause mental distress. In standing or walking he had a difficulty to keep his body properly balanced. He also suffered from noises in the head, sick headache, nausea, bad sleep, and distressing sensations shifting from one place to another.

Influence of Sex.

The male sex is more liable to this neurosis than the female, and this relation seems to be, at all events in England, fairly constant. In 541 cases which I had observed up to 1894, when the fourth edition of this book appeared, the percentage was 67 for men and 33 for women; while in a further series of 125 cases, seen from 1894 to 1897, the percentage has turned out to be almost identical, viz.: 66·4 for men, and 33·6 for women. This cannot be accidental. Most women suffering from this neurosis are artists, professional nurses, post-office employés, telegraphists, and shopkeepers. In others severe and long-continued uterine disease, repeated pregnancies, difficult labours, and unduly prolonged lactation have appeared to me to give rise to the neurosis, more especially when the events were accompanied with mental distress and depression.

In Germany the proportion between the sexes seems to be different from what obtains in England, for Binswanger[7] states that in his practice the sexes appeared to be about equally affected; while Bouveret,[4] who has written the best French book on this subject, does not mention the influence of sex at all.

The greater prevalence in men which I have observed in this country, is probably owing to the fact that in the struggle for life men are more exposed to injurious influences than women. When, however, women will have succeeded in placing themselves on a more equal level with men, they will probably suffer even more from this malady than men, because they have, in the main, less power of resistance. It is often stated that women become hysterical where men are neurasthenic; but such is by no means the rule, as many instances of pure failure of brain power occur in them without a trace of hysteria.

A young woman, aged 21, whose family history was unimportant, had been ill for eighteen months when I first saw her. Before she broke down, she had a very hard place in a confectionery shop, which was also a post-office, and she was incessantly busy from morning till night. After some years of this life, there were sudden symptoms of failure of brain power. She seemed quite lost, could not remember anything that she had to do, and had a sensation as if her brain were turning round in her head. She felt so sleepy in the day that she could hardly keep her eyes open, while in the night she was restless and excited. She also complained of sensations of crawling and pressure on the head, but of no actual pain; and there was great tenderness on cranial percussion, more particularly on the vertex. Her memory seemed to be nearly gone, and she was completely disabled from following her occupation. At times she appeared almost comatose. The tendon reflexes were throughout greatly exaggerated. There was, however, no evidence of organic brain disease, and she made an excellent recovery after six weeks' treatment.

Very similar symptoms occurred in the case of a schoolmistress, aged 28, single, after incessant hard work for a number of years, unbroken by a single holiday.

Influence of Age.

The age at which this neurosis is apt to develop is chiefly that of the greatest physical and intellectual activity, viz., between 20 and 50 years. In 541 cases which have occurred in my practice up to 1894, the ages were as follows:—

From	10	to	19	years	37	cases,	6·8	per cent.
,,	20	,,	29	,,	169	,,	31·2	,,
,,	30	,,	39	,,	130	,,	24·0	,,
,,	40	,,	49	,,	86	,,	15·8	,,
,,	50	,,	59	,,	73	,,	13·4	,,
,,	60	,,	69	,,	46	,,	8·5	,,

The three decennia from 20 to 50 are, therefore, responsible for 71 per cent. of all the cases.

In a further series of 124 cases which I have seen from 1894 to 1897, the ages were as follows:—

From	10	to	19	years	0	cases,	·0	per cent.
,,	20	,,	29	,,	37	,,	29·9	,,
,,	30	,,	39	,,	39	,,	31·4	,,
,,	40	,,	49	,,	29	,,	23·3	,,
,,	50	,,	59	,,	15	,,	12·9	,,
,,	60	,,	69	,,	4	,,	3·2	,,

that is, 84·6 per cent. for the period from 20 to 50 years.

The influence of *uterine disorders* appears to have been much exaggerated. It is true that women who are subject to abundant hæmorrhage after parturition, and who get children in quick succession, or who suffer from amenorrhœa and other uterine disorders, are occasionally found to suffer from encephalasthenia, but much less so than has commonly been supposed. In really severe ovarian or uterine disease, such as cancer, myoma, cysts, etc., symptoms of the neurosis are habitually absent. The time is fortunately past when gynæcologists insisted on referring every slight symptom of nerve pain or similar disorder to displacement of the womb, and ill-treated this long-suffering organ with local interference to such an extent that the attention of the patients was constantly drawn to that part. This led to auto-suggestions, which made Playfair exclaim that many women had pessaries on the brain.

The Menopause.

It is different with the climacteric epoch, as the cessation of menstruation is an event of the highest importance in the life of a woman, and often leads to a complete change of temper, and instability of brain power. While some women traverse the critical period unscathed in their nervous powers, others suffer from various forms of nervous derangement, and even become insane. Eliot,[131] and Savage,[132] have lately drawn attention to this subject, and I have in my own practice met with several cases confirming the views expressed by these observers.

A married lady, aged 43, had at the time that her menses were becoming scanty and irregular, about eighteen months ago, a peculiar attack of illness, in which she had suffered from flushes of heat, followed by shiverings, headache, with fulness in the head, singing in the ears, some degree of deafness, and extreme irritability of temper alternating with mental depression. About six weeks afterwards she appeared to be quite her usual self again; but another similar attack came on six months after, from which she again recovered. She had a third attack quite recently, and when I first saw her, I found marked symptoms of mental depression. The memory was impaired, she seemed to have lost all volitional power, did not care for society, of which she had formerly been an ornament; could not read a book or cast up a column of figures, spent hours over the composition of a short note, and often said something quite different from what she meant. She had great difficulty in moving about, and could not keep the straight line, but walked zig-zag fashion, and had a feeling of numbness in the legs. She said that "she felt all over like ice." Her sleep was much disturbed: she awoke generally at 3 a.m. with dull heavy feelings at the back of the head and could not go to sleep again. At dinner, however, she would often go fast asleep, whether company was present or not, and would remain seated quietly on her chair without falling off. When asked why she did this, she replied that she could not help it. There was loss of appetite, and constipation of the bowels. The tendon reflexes were exaggerated. Six weeks after I had first seen her she appeared to have completely recovered her usual health, but I am unacquainted with the further progress of the case.

Similar symptoms may occur when the menopause is prematurely induced by double ovariotomy.

Sexual Troubles in Men.

Masturbation rarely leads to the development of organic disease of the brain or spinal cord, but is not unfrequently the cause of epilepsy and of encephalasthenia in those predisposed to such neuroses. Sexual abstinence never hurts a healthy man who has an occupation which interests him, and takes plenty of physical exercise; and those medical men who recommend young men to indulge in their passions, incur an extremely grave responsibility. Sexual excesses and irregularities are indeed far more productive of nervous troubles than abstinence.

Spermatorrhœa and unduly frequent nocturnal emissions of sperma often lead to failure of brain power. Goodhart[133] seems to me to be in error when stating that there is no such disease as spermatorrhœa, although it appears in the list drawn up by the Royal College of Physicians, and that it may be "relegated to its proper position in the individual's mind by a short lecture upon the most elementary physiological principles." This passage seems to show that Goodhart has never seen a case of real spermatorrhœa, which he apparently confounds with physiological nocturnal emissions of sperma. Spermatorrhœa is indeed a very tangible trouble, and often reduces the patient suffering from it to a perfect wreck. To reason such a person out of his complaint by ten minutes' conversation would smack of the marvellous, and this cannot be admitted in Medicine.

Amongst other sexual troubles in men which must be mentioned in connection with this subject is *varicocele*, the presence of which appears to have occasionally an extraordinary influence on the mind of the patient, who constantly broods over his condition, and after a time finds himself utterly unable to pursue any sustained work. Neuralgic pain in different parts, palpitations, dyspepsia, chilly feelings, followed by profuse perspiration, are likewise complained of; and there is such depression, hopelessness, and despair as may lead to suicide. It would seem *primâ facie* likely that it is not the varicocele itself, but simply the unfounded and ignorant fear excited by that condition, which in such cases gives rise to the neurosis; but it is a singular fact that certain nervous symptoms are much more pronounced on the side on which the varicocele is found to exist, and which is habitually the left side. Such symptoms are numbness, feelings of cold alternating with heat, excessive perspiration, and intercostal neuralgia. If the varicocele is treated by means of electricity or by surgical operation, there is generally rapid improvement in the patient's condition. Varicocele produces such injurious effects apparently only in those who have a neurotic inheritance.

Neuralgia of the testicle and irritable testicle must also be mentioned as occasional exciting causes of the neurosis.

Mental Influences.

A shock to the affections and passions, fright, terror, rage, anger, envy, alarm, disgust, long-continued anxiety about money matters or the health of near relatives, grief for the loss of relations, domestic unhappiness, "black sheep" amongst the children, disappointed ambition, and want of success in life, etc., may likewise lead to the outbreak of this neurosis.

A merchant, aged 35, lost his wife seven years ago in a confinement, and this gave him such a shock that he had never been well since. In addition to this he had to manage two businesses at the same time, and was constantly overworked. He complained of intense depression, and of a feeling of heat in the head. He also felt sometimes so giddy that he was obliged to support himself when walking or standing.

A private secretary, aged 22, complained that immediately after a similar shock "he had lost all brain power." He was so nervous and depressed that he was tempted to commit suicide; he seemed utterly indifferent to everything except his miserable sensations. He could not fix his attention or compose a letter, and all he could do was to write letters to dictation.

A married woman, aged 32, had been in fair health until she was 21 years of age, when her father poisoned himself. "That one night turned her into stone," and always comes back to her. She had two daughters who were violently addicted to masturbation, "letting no opportunity slip to do it." An uncle committed suicide two months before her last confinement, and this seemed to finish her altogether. She is now in general quite prostrated, has impaired memory, and is unable to write a letter or to add up figures; the children drive her wild, and the most trivial things upset her. She has a good husband, and has no need to worry; but everything is a trouble, and engaging a new servant drives her to distraction. She dreads becoming insane, and feels as if she were driven into a corner, from which there is no escape. She bursts out crying on the slightest occasion, feels always dreadfully depressed, and is so exhausted that she has to sleep the better part of the day.

A boy, aged 9, who had been apparently perfectly well before, was frightened by a fire which occurred just opposite to his house during the night, having been suddenly awakened by screams of "Fire!" After this he was completely unsettled, complained of his head, was unable to learn his lessons, and constantly felt so frightened that he would not be induced to go to bed without his father, and would often get up in the night, go to his father's bed, and feel whether he was there. He recovered under the influence of electrical treatment. Bachelors are more liable to the malady than married men; but where there is lack of peace at home the influence of marriage may be prejudicial.

A Faulty Education.

An education which is either too strict or too lax may, in neurotic children, lead to the condition which we are now considering. A young lady complained to me that she had had a most wretched childhood. Her father and mother separated before she was born; and she was put out to nurse with low and coarse people. She never saw her father, but after his death her mother took her to live with her. The mother's means were straitened and her temper soured, so that the girl was almost worse off than she had been before. When 18 years of age she had a thorough nervous breakdown, and said that she had never known a day's happiness in all her life.

School-teachers are apt to complain that want of proper attention is becoming lamentably frequent amongst children, and attribute it to over-pressure in education. When medically examined, such children are found to be troubled with pressure on the head, sleeplessness, wretched feelings of depression, palpitations of the heart, sexual neuroses, etc. Sir Crichton Browne found that out of 6,580 scholars in School Board schools in London, 40 per cent. of the boys and 52 per cent. of the girls suffered from neurasthenic symptoms. In these cases, however, indifferent feeding was an active cause. Nesteroff,[134] who has examined chiefly the pupils of middle-class schools in Russia, found that, out of 588 persons, 30 per cent. suffered from pressure on the head, neuralgia, and cardiac and sexual neuroses. The numbers increased in proportion to the more advanced forms in which the scholars were, so that while in the preparatory class there were only 8 per cent., there were 22 in the second, 44 in the fourth, 58 in the sixth, and 69 per cent. in the eighth or highest form. Numerous observations made on this subject in the German schools, where the claims made on the pupils' brain power are probably greater than anywhere else, tend to show that normally constituted children show no ill-effects from so-called "over-pressure," and that injurious results follow chiefly in those who have inherited a neurotic tendency, or are naturally of a sluggish disposition. A too exclusive attention to the development of the mental faculties, particularly in ill-ventilated school-rooms, and neglected physical exercise, however, is likely to add to the trouble, and so may be the detestable habit of giving opium or alcohol to children.

Cajal has ably pointed out that educational influences are able to modify the condition of inter-cortical associations in the brain of the child. During the period of development, the influence of parents, teachers, reading, and other factors of moral environment, must lead to types and kinds of cellular association in the brain which differ for each child, and on which depend the formation of character and the mental faculties of the adult. If prejudice, fanaticism, scientific, religious, and moral aberrations become developed, there will be exclusive and abnormal associations between certain groups of cells leading to unreasonable notions, contempt of science, superstition, credulity, and other mental abnormities; while, on the other hand, an education based on positive ideas, on wholesome and noble sentiments, on correct views of science and society, will promote the physiological association of groups of cells, and lead to the formation of a man of sound judgment, freer from prejudices, and fit to cultivate the sciences and arts.

In consequence of faulty education of children, there are probably few brains, the architecture of which has not somewhat suffered, and where besides normal associations, faulty connections have not been formed. Even in highly-gifted persons there is therefore often narrow-mindedness, partiality, and self-conceit. The evil results of a faulty education are, however, chiefly noticed in political, religious, and literary partisans. Every political, philosophical, and artistic school causes in its adepts a type of association of ideas, judgments, and reasoning which are so exclusive and narrow that they must be connected with the existence of special and systematised associations of nerve-cells. These kinds of inter-cortical association are not unfrequently antipodic, as shown in such contrary phenomena as materialism and spiritualism, realism and idealism, socialism and individualism, etc. Where such systematised associations have been formed in youth, and reach that degree of strength which is habitually called conviction—whether right or wrong, and whether political, religious, or philosophical—a definite constitution of the brain is the result, and to attempt to modify it would be equivalent with changing the anatomy of the brain and the individuality of a person. One may be sure that the brain of a positivist does not work in the same manner as that of a spiritualist, and the physiological differences between them must be based on structural differences, which can only be altered in course of time, and by the instrumentality of numerous opposite ideas.

Over-work, Worry, Prolonged Mental Strain.

Influences like these are powerful exciting causes of the neurosis. Strong men are able to do on occasions an enormous amount of work without suffering from more than fatigue; but where over-work is habitual, and the brain originally not strong, it must suffer, more especially where the work is monotonous, or disliked by the worker. The exact manner in which over-work proves injurious is not well known, but it seems permissible to assume that intra-cellular oxidation in the brain is proceeding too rapidly in these cases, and that excessive catabolism leads to blood-poisoning.

An artist, aged 32, married, had for more than ten years over-worked himself to an excessive extent, being almost constantly at work from 5 a.m. to 11 p.m., swallowing his meals in a great hurry, and often playing two or three games of chess simultaneously while he was doing his drawings. He worked for a number of illustrated papers, and the work had to be done at a moment's notice. He would receive a paragraph cut from a newspaper, and was requested to illustrate it forthwith. Four years before I first saw him he broke down; he did not know what he was doing, was in a kind of nervous fever, got out at the wrong station when travelling on the Metropolitan railway, lost his way in the streets, and it became almost impossible for him to attend to his occupation. When he had finished a drawing he would faint away. After a time, symptoms of writers' cramp supervened on those of general brain exhaustion, and even when not working he felt numbness and pain in the right arm and fingers. When he first came to me, he felt wretchedly ill all over, and thoroughly played out; he could not sleep, eat, or work, and had fulness and pain in the head. The kneejerk and most other tendon reflexes were exaggerated, but there were no signs of organic brain mischief, and the patient made a very fair recovery.

A tradesman, aged 35, married, had been generally in delicate health, and had been twice operated upon for fistula in ano. He had, however, always been able to attend to his business, in which he was successful, and had no other anxieties or troubles. He had a short time before he came to see me been terribly over-worked, and suddenly found that his memory was apt to fail him. He forgot appointments, and did not remember whether he had done certain things or not; he also, after paying his assistants, worried whether he had done it correctly or not. He complained of headache, confused feelings in his head, of low spirits, sleepiness during the day, and a sensation of utter weariness. He was now habitually intensely thirsty, and there was polyuria, the average quantity of urine passed during the twenty-four hours being 120 ounces. The average density was 1010. There was no glycosuria.

Reading hard for examinations is a frequent source of similar troubles. Students of law and medicine are often, previous to examinations, seized with such pressure on the head and consequent inability to understand what they are reading, that they are obliged to give up their career. The same may occur after they have passed, or have been plucked in examinations. Sometimes a single mental strain is enough to lead to prolonged suffering. Such was the case of an American gentleman who had sold a cattle ranche, and had had to count 35,000 head of cattle over to a purchaser. Immediately after he had finished this, he was seized with distressing head-symptoms which continued for more than twelve months.

Clergymen working in the slums of large cities with the view of reclaiming outcasts are very apt to suffer in this manner, more especially if they abstain from the use of stimulants in order to give a good example. One of the most severe cases which I have had under my care was that of a priest, who, in addition to an almost incredible amount of work amongst the poor, had been in the habit of snatching a few hours from the night in order to do literary work for the purpose of increasing his income, and never took any wine. Many teachers of music give lessons in young ladies' schools for ten or twelve hours consecutively, and at last talk just like machines, without really knowing what they say. They afterwards suffer from stupid feelings in the head, and have a difficulty in speaking and arranging their thoughts.

The cry for eight hours' work amongst the lower classes appears, indeed, absurd, when we consider the infinitely longer and more exhausting labour which is habitually performed without murmur by lawyers, doctors, clergymen, and other brain-workers. Indeed, the classes suffer far more from failure of brain power than the masses, probably because they work harder and do more exhausting kind of work than mere manual labour; besides which, they are more exposed to anxiety and depressing emotions than the lower orders. I have, however, seen a number of cases of this neurosis amongst skilled artisans, who stand nearest to the professional classes.

Over-work is particularly hurtful where there are flaws in the family and individual history of the patient. Such was the case of a merchant, aged 32, who had had irregular sexual habits, and suffered from gonorrhœa and syphilis six years ago. This was followed by eruptions on the skin, varicocele, and a node on the tibia; but during the last two years there had been no active symptoms of the specific disease. His nervous symptoms, however, had no connection with the latter, as they had commenced to trouble him four years before he had acquired it. His family history was bad, for his mother had suffered from melancholia. He attributed the first symptoms of his nervous ill-health to over-work and excitement in business. He felt so bad after a time that he thought his food must be poisoned, and this delusion lasted for some time. His health, however, presently improved, and he was again able to work. About six weeks before he came to see me, he had a relapse of nervous symptoms. He found himself quite unable to attend to business, could not listen to a conversation, and was often obliged to rush out of the room and walk about. His memory was impaired, and there was intense mental depression. The least annoyance or excitement nearly drove him wild. He complained of a headache of a peculiar clawing character, and was unable to sleep or to digest his food. His tongue was red and furred, and his pulse feeble. He had great difficulty in thinking, speaking, and writing a letter. Under treatment he quickly improved, but had a series of relapses during the next few years, when he was over-worked or subject to much excitement. On the whole, however, his progress has been satisfactory.

When over-work is combined with irregular habits, intemperance, etc., the liability to a nervous breakdown is increased.

A merchant, aged 41, married, had on the whole enjoyed good health, but nine years ago had over-worked himself in business, kept late hours, and was obliged to "drink with customers." He then broke down suddenly, and was "laid on the shelf" for eighteen months. As soon as he felt able to resume his occupation, he commenced the same sort of life again, when a second similar attack occurred, which had lasted for two years when he came to see me. There was tenderness on cranial percussion, complete want of energy or interest, impossibility of fixing the attention, great depression of spirits, with temptation to commit suicide, tendency to burst into tears, loss of volitional power, and considerable physical debility, without evidence of organic disease.

Omnivorous Reading.

A gentleman, aged 50, had been peculiar when quite young, and inclined to indulge in grandiloquent language. He was an omnivorous reader, a hard student, and very inquisitive; he devoured books, newspapers, magazines, and all kinds of literature, ephemeral as well as solid. The circumstance that some of his relations had risen to high positions had a prejudicial influence on his character, as he considered he was bound to succeed like them, and therefore read incessantly. He was warned that he would break down, but to no purpose. At last he began to complain that his brain refused to work, he could not fix his attention, or carry through a train of reasoning, and when he made the attempt he suffered terribly. Sleep brought no rest, and he was never free from malaise of the most irksome and depressing kind. He had curious notions about the importance of his case, which he considered so unprecedented and awful that his doctors ought to give their whole time, days as well as nights, to the study of it; while he considered those who refused to believe in his sufferings guilty of an amount of cruelty, selfishness, and stupidity that could not be surpassed. Seeing other people engaged in work annoyed him, because he was unable to follow their example. He complained of a contracted and collapsed state of the brain, which seemed to him a sort of "immovable fixture," and made exercise of the mental faculties impossible. There was a want of elasticity, of power of reproduction of ideas, and resuscitation of what he had seen or heard. He obtained no mental recuperation from sleep, but often the reverse, and was subject to distressful awakenings. He felt certain that sleep produced disastrous effects, and had a destructive influence on his brain. He "considered it a hopeless task to rescue him from the bottomless pit—so formidable as to be beyond human power; any one who gave him hope would be guilty of gross presumption: and, if he succeeded, would have performed a greater miracle than any recorded in the Old or New Testament." While, therefore, his brain felt always enclosed in a vice, sleep seemed to put an additional screw on the victim. "Try and rouse yourself" appeared to him the same as if a blind man could be made to see, or a paralysed one to walk, simply by trying to rouse himself. In this case the optic discs appeared slightly hazy on their margins, as if there had been a mild attack of optic neuritis which had not gone on to serious organic changes. The colour sense was imperfect, and hypermetropia was present.

Nursing the Sick.

Long continued *nursing of the sick*, especially by ladies untrained for that profession, is likewise a fruitful cause of the neurosis.

A lady, aged 45, insisted on nursing her daughter unassisted through a dangerous illness, which lasted about four months. During the whole of that time she slept neither night nor day, was constantly racked with anxiety, neglected taking her food at proper times, and did herself alone the work of two nurses and one servant. One morning, when the daughter had been pronounced out of danger, she suddenly felt the most fearful sensations in her head, and indeed all over, as if she were being gradually crushed into atoms by powerful machinery. She was now for a time like one paralysed and imbecile, lost all interest in herself and her children, and, when she was able to get up again, felt so utterly wretched that she several times attempted her life. She eventually recovered after four years' illness.

An unmarried lady, aged 25, had been in good health until her father was seized by a serious illness which required constant attention and nursing, while she had at the same time the charge of a sister who was somewhat deranged, and had a most violent temper. These troubles gradually told upon her strength; and when, some time after the death of her father, she wanted to return to her favourite occupations, she felt herself utterly incapable of going on with them for any length of time. She had been a student at the School of Art, and was very fond of painting; but when she attempted to do it, she got such fearful feelings of unsteadiness, pressure, and discomfort in her head that she was obliged to lie down and keep perfectly still. Nor could she play the piano, in which she had formerly excelled, nor read a whole page of a book at a time. When she received a letter she often left it a whole day in her pocket without venturing to open it, and ultimately asked a friend to read it to her. She disliked society, and even the ordinary conversation in the family circle was too much for her. She could only sit up for a very short time, and mostly spent the day lying on a couch. There were not the slightest symptoms of hysteria or affectation about the patient, who on the contrary suffered intensely from her enforced idleness, as she was ambitious and desirous of distinguishing herself. Cranial percussion elicited tenderness in the region corresponding to the frontal lobes: otherwise there was no sign of disease. She made a satisfactory recovery.

In such and similar cases it is probable that only one hemisphere suffers, while the other is ready for action; but that work begun by the latter reacts so unfavourably on the former, that overpowering distress necessitates the signal "cease firing." The case just related might therefore be described as one of *disturbed cerebral dualism.* Faust says:—

> Zwei Seelen wohnen ach! in meiner Brust,
> Die eine will sich von der andern trennen.

That this is no mere poet's fancy is shown by many facts in psychological medicine.

The most striking case of such dual action of the hemispheres with which I am acquainted is that of the celebrated German physicist Fechner,[135] who has written a highly interesting description of his own case, with that keenness of insight and observation for which he was famous throughout a long life. Failure of brain power supervened in him, in consequence of excessive mental labour and strain, at the age of 40, there being no neurotic predisposition in his family. The principal symptoms were fulness in the head, insomnia, and depression; when after, and evidently in consequence of, a most fatiguing experimental research on colours, which required very close application of the eyes, photophobia and inability to use the eyes for reading and writing came on. At first the fear of light was moderate, but it gradually increased so much that he eventually became confined to a dark room, and could only go out with his eyes bandaged. Some time afterwards he also became troubled with an incessant glimmering of light in the eyes, and reading, writing, and other work became impossible. Fechner relates most graphically how he spent the day in restraining as much as possible the current of his thoughts, which, apparently from want of work and occupation, raced along independently of volition. If any subject had only the slightest interest for him, his thoughts began to revolve round and round it, constantly returned to it, bored and ploughed themselves as it were into his brain, and still further impaired its condition, so he had a distinct feeling that his mind would hopelessly perish if he did not strain every nerve to combat this state. It was often the most insignificant things which took hold of him in this manner, and he had to work for hours, and even days, to remove them from his thoughts. This work, which he carried on for about a twelvemonth, during the better part of the day, was indeed a kind of occupation or entertainment, although one of the most painful which could well be imagined; but it was not unsuccessful, for he attributed to the consistency with which he carried it out, the eventual recovery of his mental powers, or at least looked upon it as an indispensable preliminary condition, without which such recovery would have been impossible. His *mind was as it were divided into two parts*, viz., his Ego, and his thoughts. Both combated one another. The thoughts endeavoured to overwhelm the Ego, and to pursue a self-willed masterful course, which if unopposed would have destroyed his freedom and health; while the Ego strained all its volitional power in order to control the thoughts, to banish them as soon as they tended to fix and develop themselves, and to substitute other more remote thoughts and ideas in their place. His mental occupation was therefore not to think, but to constantly banish and restrain thoughts. He often, while in this state, felt like a rider who endeavours to gain the mastery of a horse which has shied and run away with him, or like a prince against whom his people have rebelled, and who seeks gradually to collect forces and troops for reconquering his kingdom. A thousand times he wished for death, and would willingly have sought it unless he had been convinced that he would have gained nothing by such a sin, but would have in a future life to undergo anew the sufferings from which he wished to escape in the present.

He eventually recovered his intellectual power by a long and painful course of self-training, during which he discovered that boldness in the use of his eyes, as well as of his head, was useful; while fear and timidity tended in the opposite direction. In after years the condition of his eyes varied a good deal, being sometimes better and sometimes worse; yet he was able to undertake an enormous amount of original experimental research, of which his published works bear witness; and he died at the age of 84, with his mental powers unimpaired.

The remarkable variety of moods, which so frequently provokes criticism in the case of a youthful Sovereign of our own time, may perhaps be accounted for by a similar dualism as that which Fechner described in himself. It has appeared to many observers that there are two souls struggling for the ascendency in that gifted ruler. One of them is the soul of the greatest of his ancestors, who was in his time "*facile princeps*" in council as well as in war. If this soul were the only one of our present subject, it would have made him a Conservative, religious, and self-opinionated prince, looking upon himself as *summus episcopus* of his country's Church, as the absolute "war-lord" of countless legions, and as the despotic master of men, as all his ancestors did before him. But there is believed to be a second soul in him which is absolutely modern, especially in the selection of means, and is characterised by a lively imagination, a quick and ardent zeal, a keen interest in science and art, more especially in new discoveries and inventions applied to everyday life, a passion for travelling, and an indubitable eloquence, an enthusiasm for the embellishment of his capital, for great deeds and great ideas, and finally love of pomp and colour.

Want of Occupation

may be as injurious to the brain as overwork. Persons who are well off, and feel no incentive to action, often spend their lives in frivolous pursuits, and may then become victims of either hypochondriasis or encephalasthenia. Numerous cases of this kind are to be found in the so-called "temples of luxury and ease," the habitual frequenters of which are often much more miserable and to be pitied than the inhabitants of slums or labourers' cottages.

Dissipation

was the cause of a complete nervous breakdown in the case of a gentleman, aged 29, single, who had been in the East for ten years when he came to consult me. He had been quite well during the first five years of his stay there, his habits having been steady then; but after that he got into a "fast set," and plunged into dissipation of every kind. After a month of this life he was seized by intense depression of spirits, a feeling of utter misery, and inability to do anything. He had severe pains in the spine, an anxious expression, and a feeble pulse; he complained of constant headache and giddiness, loss of memory, utter inability to fix his attention, and a tendency to brood about his condition. He often burst into tears without any cause, and could not take the slightest interest in anything. There was great tenderness in the cervical spine, loss of sexual power and "nasty sensations" in the testicle, where a medium degree of varicocele existed. The tendon reflexes were everywhere exaggerated, and the muscular power was feeble (90° right, and 80° left hand). The urine, however, was normal, and the family history good. A curious symptom was intense irritation in the skin, more especially of the lower extremities, without any rash or other objective symptom. There was also great cardiac debility, with faint feelings in exertion, as on going upstairs, etc. The pulse was of low tension, and varied from 100 to 140. He slept habitually badly, and suffered from frequent nocturnal emissions. He made a good recovery.

Syphilis.

Syphilis, which leads so often to grave organic mischief in the nervous system, is also one of the exciting causes of the neurosis which we are now considering. It appears to act either by inducing deterioration of the blood and nutrition, or by the depressing effects which the consciousness of past infection exerts upon the mind. The latter was evidently the case with a clergyman, aged 48, married, who had had syphilis twenty-five years ago, and from having been in splendid health before, had become nervous and anxious, and subject to an infinite variety of other nervous troubles. He came from a healthy stock, but had ever since that unfortunate event "been under a cloud." When he came to see me, he had, after some trifling worry, suddenly become subject to a variety of paræsthesiæ, which troubled him greatly. He complained of twitches and throbbings in the head, and odd feelings in the spine which seemed to move up and down; and the twitchings in the head appeared to keep time with it. His brain was now very incapable; he found mental effort almost useless, as "nothing came of it." At times there would be creeping, crawling, aching and other unpleasant sensations in all parts of the body, and this sometimes nearly drove him frantic. The lower part of the spine was extremely painful, especially when walking much. His writing was tremulous, and he could not sleep without hypnotics. I have seen a considerable number of similar cases in which there was more fear of syphilis than actual disease.

Acute Diseases.

Certain infectious diseases, such as erysipelas, typhoid fever, cholera, influenza, and others of a similar character may, during or after convalescence, give rise to failure of brain power.

(*a.*) *Typhoid Fever.*

An engineer, aged 39, married, had lived much in the tropics, and had suffered from exposure and privation. His mother had died of cancer, but his father was alive and well. He had always been temperate and of steady habits. Four or five years ago he had a bad attack of typhoid fever, from which he recovered, but found himself afterwards "quite a changed man." While, formerly, he had been active, energetic, and of a lively disposition, he now suffered from heavy, dull, and dazed feelings in the head, as if he were going to lose his reason; and felt very low and depressed, especially in the morning. He had so much difficulty in fixing his attention on anything which he had in hand, that he had been reluctantly obliged to give up his occupation. He "could not explain the feelings in his head"; he fancied all sorts of things; his memory was much impaired; he had lost all confidence in himself, and suffered from indecision, often not knowing whether he was right or wrong. He had lately been troubled with insomnia. Physically he was very strong, and could walk any distance without fatigue.

(*b.*) *Dysentery.*

An officer, 52, married, had experienced much worry and anxiety throughout his career. He had served a long time in the East, and had had severe dysentery when stationed in the West Indies. Since that attack he had never been the same man. He found his memory failing, could not retain what he read, even if he read it half-a-dozen times over, had great difficulty in composing a letter, and forgot whether he had or not done something which he had intended to do. He had constantly a heavy feeling about the forehead, slept badly, and was in a state of intense mental depression. The deep reflexes were normal, and the muscular power good (160° right, and 120° left hand).

(*c.*) *Small-pox.*

A merchant, aged 37, consulted me for sleeplessness, from which he had suffered ever since the age of 21, when he had had a bad attack of small-pox. Before then he could go to sleep at any time, and sleep as long as he liked; but on recovering from that distemper he found that he had to lie awake at first five or ten minutes, then half-an-hour and more, before he fell asleep; and he thus gradually passed into his present condition, in which he really did not sleep at all, and although lying still, was nevertheless quite conscious throughout the night, heard every cab which passed his house, and could get up at any moment. Towards 6 a.m. his condition became somewhat more of a real doze; before that time it was not even that. This made him so wretched and miserable that he felt life was not worth having; and "he had reasoned it out that suicide would be preferable to going on in this manner." He also complained of crawling sensations in the forehead and bridge of the nose, a feeling of pressure in the head, and loss of mental energy. He might well have exclaimed:—

> Sleep, gentle sleep,
> Nature's soft nurse, how have I frighted thee,
> That thou no more wilt weigh my eyelids down,
> And steep my senses in forgetfulness?

(*d.*) *Scarlet Fever.*

A farmer's wife, aged 42, coming from a healthy stock, had scarlet fever, four years before she came to see me. Since that illness she had felt so giddy that she could hardly walk or stand for swimming in the head. She staggered in standing with her eyes closed. She also suffered from polyuria and relaxed bowels. The tendon reflexes were normal. The memory and the mental faculties in general were much impaired, and she suffered from feelings of vague alarm and panic without any adequate cause.

(*e.*) *Diphtheria.*

A married lady, aged 26, had a bad attack of diphtheria while in the East, and was afterwards paralysed for nearly six months. When she got up again, she noticed that she was unable to take an interest in anything, or to resume her usual avocations; she had lost her memory and forgot to do the most ordinary things which she ought to have done. This condition continued for some time, and as she did not get better, she eventually, from having been most cheerful and energetic, became depressed and moody. I examined her carefully, and could not find any signs of organic brain disease, or any indications of mental derangement, as she had no delusions and appeared otherwise to be perfectly rational. She had, however, lost all hope of getting better, as she had been affected in this way for four years; and the next thing I heard of her was that she had attempted to destroy her life by taking laudanum. She remained for twenty-four hours in a comatose condition, from which she was rescued. Soon afterwards, however, she succeeded in procuring prussic acid, with which she killed herself.

(*f.*) *Septicæmia.*

A medical practitioner, aged 38, single, had, while house-surgeon to a hospital, a post-mortem wound, which caused septicæmia followed by abscesses, and leaving great weakness and nervous depression. He never quite regained his health after this, but found that his mental powers had shrunk, his memory was weak, he could not grasp a new subject and had general haziness and indefiniteness of perception; with this were combined irritability of temper and depression of spirits, restlessness of mind, and irresolution. He had to read a long time to get hold of a subject, and then he did not have complete mastery over it. Muscularly, he was strong, and able to bear fatigue of body, but his brain was easily tired and lacking in reserve force.

(*g.*) *Influenza.*

A married lady, aged 30, mother of one child, had a bad inheritance, for her father had died of apoplexy at an early age, and her mother had always suffered from her head, and been very nervous. Twelve months before I saw her, she had a great shock through the suicide of a near relation; but she kept in very fair condition until she had, some time afterwards, a sharp attack of influenza. As soon as this was over, an abundant crop of neurotic symptoms became developed. She felt utterly prostrate, had choking sensations, with feelings of anxiety, morbid thoughts and tendencies, fancied that she was on the point of becoming epileptic or insane, because some of her friends had been so. She had such distressing sensations in her head that she believed something was breaking in it, and that this must eventually render her insane. Her self-consciousness was so exaggerated that she could hardly think of anything else except her own condition; when looking in the glass, she thought it was not her own image that was reflected. Her occiput was very tender to percussion, and the urine contained an excess of phosphates. She was utterly unable to occupy herself, could not write a letter, or read a book, or take an interest in her affairs. Her pulse was generally 120, and of low tension. She also had, from time to time, horrible feelings at the back of the eyes and in the pit of the stomach. She would often burst out crying, and keep sobbing all day long. At meals the sight of knives brought nasty thoughts into her head; and she was so over-suggestive, that a hint once dropped by her doctor that she might have troublous times before her, made her miserable for weeks together. She made a satisfactory recovery, and remained well for a considerable time, but has had slight relapses of the same ailment since then.

Of all acute infectious diseases, influenza is more liable than any other to lead to such nervous breakdowns; and I have described a number of such cases elsewhere.[136]

Amongst the chronic cachexiæ scrofula, tubercular phthisis, and anæmia, are chiefly apt to cause failure of brain power.

Dyspepsia.

Dyspepsia is often believed to be a cause of the malady which we are now considering, but is in the majority of cases seen rather to be a neurosis of the pneumogastric nerves and their centres in the bulb, and therefore not a cause but a symptom. Sir William Broadbent[137] has recently drawn attention to the fact that dilatation of the stomach very frequently occurs in neurotic persons who have not been guilty of indiscretion in diet and other common causes of dyspepsia.

Some singularly able observations have been made on this point by Glénard,[138] who has come to the conclusion that the neurosis which we are now considering is owing to what he calls *enteroptosis*. He finds in all cases of failure of brain power the following four symptoms:—1st. Flabbiness of the abdomen; 2nd. Prolapsus of the bowel, or enteroptosis, with prolapsus of the kidneys, liver, and spleen; 3rd. A narrowing of the large bowel, or entero-stenosis, leading to abdominal pulsation; and finally, 4th. Gastroptosis and gastric atony. Systematic compression of the sub-umbilical region is, according to him, in general effective in relieving all these troubles.

Now, although it is quite true that the symptoms just mentioned occur in a certain proportion of cases of encephalasthenia, there is a much larger number of other cases in which there are no dyspeptic troubles at all, and certainly neither enteroptosis nor gastroptosis.

In many other cases the symptoms of dyspepsia only appear long after other signs of the neurosis have been present. It therefore appears that Glénard has put the cart before the horse, and that, in fact, the forms of dyspepsia which he has described are owing to failure of tone in the pneumogastric and splanchnic nerves, consequent upon an inefficient condition of the bulb, and leading to atony in the muscular coat of the digestive tract; in fact, that they are secondary consequences, and not primary causes, of the neurosis.

Cold and Heat.

Exposure to cold and heat, especially when combined with over-exertion and want of food, is occasionally met with as an exciting cause of failure of brain power. A clerk in a bank, who was some time ago under my care, ascribed all his symptoms to having to work all day long at a desk immediately under a gas-burner.

Poisons.

Poisons, such as arsenic, phosphorus, mercury, lead, etc are more apt to lead to structural disease of the nervous system than to the neurosis now under consideration. Alcoholic excesses are a common cause of peripheral neuritis and of insanity, but may also lead to failure of brain power. Excessive smoking is often followed by cardiac neuroses, through the paralysing influence which nicotine exerts on the pneumogastric nerve and its centre in the bulb. The abuse of morphine, cocaine, hydrate of chloral, and other hypnotics, tends to weaken the brain in all its parts.

Auto-Intoxication.

Organic poisons which are habitually formed in the system itself may, if their due elimination is interfered with, act injuriously on the brain functions without leading to actual disease. Such substances are, for instance, the peptones which are found in the stomach and the intestines, the aromatic acids, the phenols, and finally the leucomaines of Gautier.[139] Impaired digestion may lead to the formation of butyric, valerianic, and capronic acids, and their ammonia compounds from fats, while ammonia and sulphuretted hydrogen are formed from proteids; and finally we have real toxines or basic ptomaines, which belong to the groups of diamines, and are products of acid putrescence, and consequent specific action of bacteria, such as cadaverine, neuridine and choline, from which latter substance two most virulent poisons, viz., neurine and muscarine, may be formed by oxidation. In addition to these, we have Brieger and Fränkel's[140] tox-albumoses or protein-toxines, the chemical composition of which resembles that of albumoses and peptones, but which are intensely poisonous in small quantities if they are allowed to circulate with the blood. Poisons formed in the stomach and intestines may be partly rendered innocuous by forming non-poisonous compounds with other substances; but the principal safeguard against them consists in the action of the liver, which does not permit such poisons to enter the circulation. If, however, the quantity of toxines formed is excessive, so that the liver, although healthy, is unable to decompose all of them; or, if the quantity of poisons formed not being larger than usual, the liver is not in a fit condition to neutralise them, auto-intoxication will be the result. It is apparently in this way that the symptoms of so-called biliousness, viz., headache, lassitude, nervous irritability, and hypochondriacal feelings are produced; and when such a state is allowed to continue, actual failure of brain power may be the result.

Offences against the laws of hygiene may have a similar influence. The excessive use of purgatives; long-continued hot or cold baths or sea-baths; vegetarianism; sudden changes in the diet, in consonance with the fads of the day, such as doing Banting, Schweniger, etc., often act as exciting causes of the neurosis.

Injury to the head may lead to the same condition. A gentleman, aged 54, with an unimportant history, had been quite well until he was one day, while driving, thrown out of his carriage. There was no concussion of the brain, but a month afterwards insomnia set in, which proved to be of a particularly obstinate and painful character. After this had gone on for some time, there was a total change in the patient's condition. From having been cheerful and active, he always felt wretched, had eventually not a moment's pleasure in life, and asked his children to pray that he might be taken away. He had constantly a bursting feeling in his head, felt as if he must go mad, and said that his misery was indescribable.

A severe *strain* may have the same effect. I have seen a man who, after lifting a heavy load, about 170 lbs., "just to see what he could do," suffered from "strange feelings in his head," which were the beginning of further brain troubles.

A gentleman, aged 40, married, had, when a boy, two or three bad blows on the head which stunned him for some time. Eleven years ago he was thrown out of a gig and pitched on his head; he was unconscious for a considerable time, and was in bed for six weeks. He never had a fit of any kind, but, since the accident just mentioned, had been subject to nasty heavy feelings in the head and at the back of his eyes, which were sometimes so bad that he had contemplated suicide to escape from them. On waking he had strange sensations in the left side of the body, a kind of numbness and crawling, especially in the left leg. His chief trouble, however, happened when he had to go out. He might go on well for a mile or so, but then felt all of a sudden as if he were going to be paralysed, the perspiration streamed from his legs, he became thoroughly chilled, and felt as if it were all over with him.

Railway accidents are more liable to give rise to hysteria or to a combination of hysteria and encephalasthenia (*traumatic neurosis*) than to simple failure of brain power. The principal factor in such conditions is the influence which the commotion produces on the mind.

CHAPTER III.

THE SYMPTOMS OF FAILURE OF BRAIN POWER.

THE cases recorded in the previous chapter may be taken as illustrative of the chief groups of symptoms observed in patients suffering from this malady. A somewhat more systematic consideration of the signs of the disease, however, appears to me nevertheless desirable, and I therefore now proceed to trace these, as they are clinically observed, to failure of power in the different areas of the brain. All these symptoms, however protean in their mode of appearance, partake of a twofold character, viz., of undue excitability and irritability, and of undue exhaustibility and paresis of the neurone.

I.—SYMPTOMS IN THE INTELLECTUAL SPHERE.

A state of undue excitability in the mental centres and the cortex generally is shown by feelings of unrest and unsteadiness of the mind, excessive impressibility by comparatively trivial things, and exaggerated self-consciousness and introspection.

> With curious art the brain, too finely wrought,
> Preys on itself and is distraught by thought.

There is in many cases, especially where the patients are very intelligent, a constant worrying and brooding about the nature of the complaint from which they feel themselves to suffer, and about the meaning and significance of the various symptoms and distressing sensations to which they are subject.

In other cases we find signs of too easily induced mental exhaustibility and fatigue. The patient who may, previous to his illness, have been bright, cheerful, and energetic, is now dull, drowsy, apathetic, moody and depressed. He feels no pleasure in life, cannot settle down to his habitual occupation; is unable to read a serious book, or to compose an important letter, or to add up a column of figures. He cannot fix his attention or make a sustained mental effort. Unbidden thoughts come into his mind; he cannot follow an argument, or listen consecutively to a preacher, or a play, or a piece of good music. He complains that he cannot think, and has become stupid. There is want of readiness and alacrity about him; he cannot answer an ordinary question off-hand, but has to consider the matter first for a time before being able to reply, which gives him an appearance of stupidity, or want of straightforwardness. Nor can he do anything on the spur of the moment, but is inclined to put everything off till to-morrow, craving for delay. The thoughts are apt to wander; his head is in a miserable chaotic condition; an occupation is begun, but shortly afterwards there is an intermission of intellectual activity, the patient staring vacantly before him, and doing nothing. He has no faith nor hope, and is tormented by the dread that he will lose his reason, cannot bear to look any one in the face, and is frightened at his own reflection in a looking-glass. While there is in many cases an utter indifference to, and absolute distaste for intellectual work and occupation, there may be in others the keenest desire for it, yet the power of the sufferer to devote himself to the same is absolutely lacking, and all attempts towards it, however determined and painful, prove unavailing.

The term "aprosexia" has been coined by Grye, of Amsterdam, for designating that form of inability of fixing the attention on a subject which accompanies nasal obstruction. This latter was some years ago looked upon by some rhinologists as the source of nearly every trouble which existed in a patient, but a wholesome reaction against such exaggerated views has recently become manifest.

In slighter forms of intellectual incapacity the patient may still be able to work and give attention, although this necessitates painful efforts on his part. This was the case in a merchant, aged 34, who had made so many mistakes in his accounts that he had eventually lost all confidence in his accuracy, and went over a calculation three or four times, fearing that it was not right; and on casting up a column of figures, he shaded his eyes with his hands, requiring apparently all the concentration of which he was capable. At the same time he had become so irritable that his friends had the greatest difficulty in bearing with him. At home he was so conscious of this that he often left the house, and walked out of doors, in order to avoid unintentionally giving offence to others.

A single lady, aged 31, had been delicate all her life, and had suffered from ulceration of the womb, and from some consolidation of the left apex, for which she spent three winters at Mentone. She consulted me, however, chiefly about strange feelings in the left side of the head which she could not well describe, and which she had had more or less for the last three years. It was not headache, but pressure; when sitting down to read or write, she felt as if her head would presently burst, so that she was quite incapacitated from doing anything. The slightest exertion was too much for her; seeing friends and talking to them was a fearful infliction. She was also subject to giddiness, more especially in walking, and could therefore be only little out of doors, as she had a slouching and uncertain gait, which attracted the attention of passers-by, and led to uncharitable remarks about her. When sitting or lying down the vertigo was less marked; but both those positions were most unpleasant to her, so that she spent her day in pottering about the house. She often had a rumbling noise in the head. If any one read to her, or if she was in church, she could not follow, but only heard broken sentences.

Her memory was very much impaired. When she went anywhere with a special object in view, she forgot suddenly what she wanted to do, and could not remember the names of her friends. She never slept more than half-an-hour at a time. The menses lasted generally a week, and were very profuse, but the appetite was fair, and the bowels regular. The pulse was 80, and of low tension, and the urine normal. There was cranial tenderness on percussion, chiefly of the left frontal region, but no sickness or optic neuritis. The further progress of the case showed that the trouble was not owing to organic brain disease, but was simply nutritional in its character; and the whole train of symptoms made me think that only the left hemisphere was suffering, and that there was a disturbance of the dual action of the brain.

The patient often loses all interest in public as well as private concerns, and cares for nothing at all. He does not show any affection for his family and friends, hates society, becomes a misanthrope, and lives in a contracted world of his own, limited on every side by his all-engrossing individual troubles.

A merchant, aged 45, married, had suffered for eight years from nervous prostration when he consulted me. His illness began with mental depression; the "go went out of him"; he felt dull, easily tired, and had shooting pains in the head and ears. He shortened his hours of work, and took several long holidays, but without deriving benefit. He had always been shy and retiring, but was now morbidly so. He said, "My only hobby is now to worry, and I ride that very hard." His sleep was short; his misery began in the small hours of the morning, as he could not go to sleep again, and he was utterly wretched until he got up. He never smiled or laughed; was generally silent, had no wish for amusements; he was formerly fond of reading, but now could not fix his attention on a book or even a paper. Latterly thoughts of suicide had come into his head when the misery appeared too great to be borne any longer. He had a constant pain in the lower part of the spine, which was increased by walking; and the least fatigue brought on neuralgia in the right thigh, which at other times felt numb. He often spent the day on the sofa, mind and body exhausted with fatigue, and tried to sleep, but could not.

Indecision is a very common symptom in such cases. There is no firmness of purpose, and the patient often appears like a broken reed.

A medical man, aged 40, single, who had been an attendant on lunatics and travelling with them, suddenly began to imagine that he would be afflicted with general paralysis, and could talk or write of nothing but himself and the strange sensations which he experienced. He could hardly speak on any subject apart from his complaint for any length of time, but found his attention wandering, and would leave sentences unfinished. He suffered greatly from depression, pain in the head, confusion and incoherency; and attached exaggerated importance to trifles. But the most striking symptom was that of indecision and procrastination. He would, for instance, spend four or five hours writing and re-writing a letter, and then stand for an hour or more before a post office box, hesitating whether he should put it in or not; and whenever he did anything, he felt it to be the wrong thing as soon as he had done it.

In many cases the patient's conversation with his family turns on nothing but his past and present symptoms, on which he can descant for hours together, thus making himself disliked and unpopular, so that his oldest friends eventually consider him a nuisance. His thoughts about the Ego are so overwhelming that he has a difficulty in attending to anything else. His memory often appears impaired, because anything which does not concern his own wretched condition makes little or no impression upon him, and is therefore easily forgotten. There is in such cases no real amnesia, but simply distraction and want of attention, for the patient remembers distinctly anything that may have happened to him before his illness.

In other cases, however, there is actual *loss of memory*, sometimes to such an extent that the patient cannot tell his own age. Memory, that "warden of the brain," that golden thread which links all the mental gifts and excellencies together, that prime and fundamental power, without which there can be no other intellectual operation, is found to be truly impaired, and in some instances almost gone. A gentleman who, before he was thus taken ill, had a magnificent memory and the highest intellectual attainments, complained bitterly that, from having been a great Oriental scholar, his mind had become a perfect blank for Sanscrit and other Eastern languages.

A single lady, aged 42, who was employed as manageress in a large drapery establishment had, in consequence of domestic troubles, gradually lost her memory to such an extent that she could hardly recollect a single name or address of the numerous customers with whom she had to deal. When she had to give an estimate for some work, and had nearly finished it, she suddenly found that she had forgotten all about it, and had to do it all over again. She had been fond of reading in her leisure hours, and still continued to do so, but found that soon after closing the book, she did not remember anything of it, not even the title or the name of the author. She found her work very trying, as five or six people were constantly talking to her at the same time wanting directions, even while she took her dinner. Her sleep was disturbed, and she suffered from such intolerable headache that she was afraid of becoming a lunatic: other symptoms were vertigo, retching, sickness, and constant tingling in the hands and feet. She made a good recovery.

The association neurones of the cortex appear to be handicapped by the numerous distressing and painful impressions which they receive without intermission, by compulsory or imperative thoughts which cannot be restrained, and by feelings of vague dread and terror, which either crop up in paroxysms, or are more or less constantly present.

Actual loss of self-control so as to lead to improper or criminal impulsive actions is rare, for in most cases there is still power to inhibit impulses before they are carried out. Such persons may feel a sudden desire to scream "Fire!" when sitting in a theatre, and to cause a panic amongst the audience. Others have the temptation to jump out of a second-floor window, or into the water, or into the engine-room of a steamboat, or to throw themselves before a railway train which may happen to be passing; or there may be an impulse to steal, to strike others, or to spit into somebody's face, without the slightest provocation on the part of others.

A tradesman, aged 37, married, commenced two years before he came to see me, to get very nervous about himself. He could not look at his children without thinking that he must murder them. On one occasion he felt so bad that he threw his razors into the river, and very nearly jumped after them. He often burst out crying from being so low-spirited, and prayed to be taken away.

> The blackest ink of fate was sure his lot,
> And when fate wrote his name, it made a blot!

Suicide is indeed frequently contemplated, but rarely committed. I have, however, met with cases where the intention was carried out in the most determined manner.

Loss of self-control is often shown by irritability or irascibility of temper. In many persons such a temper is habitual, but in the cases under consideration there is often a decided and sudden alteration of an habitually placid frame of mind.

A merchant, aged 47, had on the whole enjoyed good health, and had been a particularly even-tempered man, until after great and prolonged excitement in business, "from having been a lamb he had become a tiger," more especially in his domestic relations. The least thing which went wrong upset him so much that he was nearly beside himself; and he became violent on the slightest provocation. He felt sorry and ashamed for such outbursts of temper afterwards, but was utterly unable to restrain himself at the time. His intellectual powers had diminished; he was not so keen in seeing his chances in business as previously, and had lost large sums of money in consequence. His memory for names had become worse; he slept badly, and drank ale and brandy in bed in order to procure sleep. His recovery after some months' treatment showed, however, that the symptoms mentioned were not owing to serious brain disease.

Loss of control is in some cases shown by the extraordinary and unreasonable *hurry* with which patients perform their occupations. An engineer, aged 45, had a bad inheritance on his father's side. His paternal grandfather had, after a fairly steady life, taken to drinking about the age of 50, and his father had done the same thing. Both had died a few years after this change in their habits from gradually ingravescent brain disease.

The patient himself had found, without any apparent cause, during the last six months that he did not do his work as well as before, lost interest in it, worried unnecessarily about things, forgot what he had to attend to, and was frequently subject to drowsiness and confusion. He found himself easily distracted, wanting in decision, and apt to hurry about everything. When he had letters to write his pen actually galloped over the paper; he would finish his dinner sometimes in less than ten minutes, and spoke so quickly that it was distressing to listen to him. At times he felt that he could restrain himself and be more steady, while at other times he could not help "racing" through everything he had to do, even when there was not the slightest necessity for it. When out of doors he walked so fast that no one could keep up with him. He also suffered from tachycardia owing to loss of control in the pneumogastric nerve, and his heart often raced as fast as his hands and legs would do.

A *deterioration in manners* is perceptible in many such cases. The patient becomes slovenly in his dress and general habits, and his conversation in the presence of ladies may show total loss of the feeling of decency.

Insomnia.

> Sleep that knits up the ravell'd sleave of care,
> The death of each day's life, sore labour's bath,
> Balm of hurt minds, great Nature's second course,
> Chief nourisher in life's feast!

Want of such restorative sleep is of very frequent occurrence in encephalasthenia; indeed, insomnia is sometimes the first of all symptoms, and often overshadows all others. Really sound sleep is impossible without a complete suspension of the activity of the cortex. The spinal cord does not sleep, for the sphincters remain active throughout the night; indeed, the reflex action of the grey centre of the cord appears then to be rather increased; for erections occur in sleep long after they have ceased to take place in the waking condition, and many patients suffering from locomotor ataxy, who have incontinence of the urine at various times in the day, retain their water perfectly while asleep. The medulla oblongata, likewise, does not sleep, but seems to doze, as it acts less energetically in all respects. Respiration and the heart's action continue without interruption, but are not so active as during the day. The vaso-motor centre is evidently drowsy, for there is considerable dilatation of the blood-vessels in the surface of the body, in consequence of which the brain and other viscera tend to become anæmic. The excretion of carbonic acid is diminished, and digestion and urinary secretion are retarded. The parts of the brain which really do sleep are, therefore, the emotional centres in the mid-brain and the whole of the grey surface. The great object of sleep is to remove products of waste from the nervous and muscular systems which have accumulated during the day, to repair the losses caused by work and exercise in the tissues, and to store up a fresh supply of intra-cellular oxygen for next day's consumption. Schopenhauer's pithy saying, "Sleep is to a man what winding-up is to a clock," therefore seems to hit the nail on the head. Sleeping and waking alternate because during waking the intra-cellular oxygen is used up, and narcotic products are formed in the tissues, which gradually accumulate and cause drowsiness. The occurrence of this shows that the energy of the nervous centres is in abeyance and requires restoration. Apart from the natural feeling of drowsiness, sleep is promoted by shutting off the stimuli which habitually reach the brain through the different sense-organs, more particularly light and sounds. As soon as sleep sets in, oxygen begins again to be stored up in the system, that received during the night being, according to Voit, double the amount of that which is taken in during the day. As soon, therefore, as a sufficient surplus of intra-cellular oxygen has been received into the system it begins to stimulate the brain, and this naturally leads to wakefulness. Protracted loss of sleep is therefore bound to cause exhaustion of nervous power, especially when combined with restlessness at night. When the patient, without actually sleeping, is yet reposing quietly, this condition may, however, continue for an indefinite time without leading to much trouble, provided he does not worry himself about it.

In appreciating the value of this symptom, which is sometimes greatly exaggerated, we must not lose sight of the fact that many persons require only a very small modicum of sleep. The great natural philosopher, Alexander von Humboldt, told me, in 1855, when I enjoyed the honour of his friendship, that for many years past he had only slept two hours out of the twenty-four, viz., from 1 a.m. to 3 a.m.; and that on waking from that short sleep he felt so much refreshed that he got up at once and resumed working; nor did he ever drop asleep in the daytime, as so many aged people do, except now and then during the last two years of his life. Humboldt appears to have spoken in much the same sense of this peculiarity to Max Müller,[133] and to an anonymous young friend,[134] who has published letters and conversations he had had with him between 1848 and 1856.

Sir Henry Burdett, the author of the "Hospitals and Asylums of the World," of the "Official Intelligence," of "Securities," etc., and one of the hardest workers of the present generation, has for many years past done with four hours of sleep or even less, which he attributes chiefly to the fact that he has always possessed the power of sleeping at any time under almost any conditions, if he wished to do so. After working until 2 or 3 a.m. he found that the brain could be "readily cooled" and natural sleep induced by reading for half an hour some light but interesting literature. His favourite "brain cooler and sleeping draught" has been an American publication called *Short Stories*, and more recently *Pearson's*, the *Strand*, and the *Windsor Magazines*. After finishing some particularly arduous work, however, he has on several occasions slept for as long as twenty-two hours at a stretch.

The same peculiarity is reported of some other eminent men. The earliest example which I have been able to discover is that of the great physician Apollonides, of Cos, that island being also celebrated for being the birthplace of Apelles and Hippocrates. Apollonides was skilled in botany, physiology, and medicine, and noted for the amenity of his disposition, the gaiety of his manner, and his taste in music and poetry, in which, as in every other attractive talent, he excelled. Ambitious of fame, but also eager for pleasure, he studied by day, passed the night in feasting, and *only slept two or three hours*. When astonishment was expressed at the short time he devoted to sleep, he replied,

"The night I rob to lengthen out the day."

He acquired celebrity at an early age, disapproved of violent medicines, employed only the gentlest remedies, was constantly planning some new contrivance for the recreation of his patients, and invented a great variety of baths, amongst which were the suspended baths. He stated that the number of bad physicians was so great that it would have been better for society had the exercise of that profession been wholly prohibited. He particularly studied the cure of hypochondria, of which he has given a wonderfully truthful description, and strongly urged the use of exercise, as this prolonged the period of youth, while rest precipitated the approach of old age. He cured the celebrated Polycrates, the ruler of Samos, of a dangerous illness, and received two talents of gold as the reward of his skill. He afterwards cured Darius, king of the Persians, of a painful dislocation of his foot, and Darius's queen, Atossa, of a cancer in her breast. In consequence of these two cures he became the favourite of the Persian king, but unfortunately for himself fell in love with the king's sister, Amytis, whom he attended and seduced. This came to the ears of Darius, whose pride could not forgive so great an insult. Apollonides was condemned to be buried alive in a cave, the mouth of which was closed with a large stone. Amytis having learned his punishment, bribed the guards, and sent to Apollonides a cup of poison, in order to accelerate his death and end his torments; and being already very feeble and emaciated, he gratefully swallowed the draught, and expired instantly afterwards.

Some patients ascribe all their troubles to insomnia, while, in general, this latter is only one of the symptoms of their complaint. They do not sleep because they feel worried and miserable, have impaired digestion, and troublesome symptoms in the urinary or sexual organs. Some complain of sleeping too heavily, and of distressing awakenings; they say that they would be well if they could only do without sleep. Indeed, to them sleep is not what it is to many others, viz., the balm and comfort of the afflicted, but wretched thoughts crowd on them as soon as they are awake, and they would say with Coleridge:—

> Sleep, the wide blessing, seemed to me
> Distemper's worst calamity!

Others have such a light sleep that the least noise awakens them, or they are troubled by distressing dreams, or as one of my patients expressed it, "by automatic cerebration of the most awful kind." The night then seems the worst part of the day, and sleep is no rest, but only a continuation of work and worry. Some people have a difficulty in first going to sleep, while others wake early after a short doze, and cannot go off again:—

> Nor poppy, nor mandragora,
> Nor all the drowsy syrups of the East,
> Will ever medicine them to slumber.

The West has now more potent "drowsy syrups" than the East ever had, but as a matter of fact hypnotics often do little good in such cases, and many patients prefer a short natural sleep to a longer one obtained with hydrate of chloral or paraldehyde.

2.—Symptoms in the Speech-Area.

Serious affections of speech do not occur in the malady which we are now considering. Sometimes, indeed, the patient appears to have a difficulty in expressing himself intelligently; he uses wrong words, does not finish a sentence, breaks off abruptly in the middle of it, and substitutes one word for another. Another peculiarity is that persons in this condition, who may have been familiar with several foreign languages, have sometimes the greatest difficulty in expressing themselves in French or German, when English comes quite easy to them. Defects of this kind, however, appear to be more owing to the patient being distracted and absent-minded, and unable to collect himself, than to any actual failure of power in Broca's convolution. I have seen several cases in which sustained efforts in public speaking have become impossible to persons who had previously the greatest facility in addressing public assemblies, but such a fault appears to be more in the faculty of collecting and marshalling facts, and keeping to a definite line of argument, than in actual loss of language.

A statesman, aged 68, who had long had a brilliant reputation for the peculiar incisiveness of his intellect, the phenomenal character of his memory, and his great oratorical powers had for about twelve months past noticed that he could not talk so fluently and connectedly as before; and on a recent occasion when he had to make a speech in the Senate, he got well to the end of the first part of it, but then could not, for the life of him, proceed with the second; in fact, he broke down altogether, losing the thread of his argument, so that, "after humming and hawing for a time," he had ultimately to sit down, to his great mortification, with some stupid remarks on the diffidence he felt in addressing so distinguished an assembly—a diffidence which he was very far from feeling. He also found that he was apt to forget long conversations which he had quite recently had on important subjects; he could not remember the names of streets in which his friends lived; and easily forgot what he had been reading. He complained of his head feeling empty, "as if the brain were wasted, or in a state of liquefaction." He could still talk brilliantly on occasions, but did not write such good letters as he used to do, and made occasional mistakes in spelling. His physical health was excellent, his muscular power, as tested by the dynamometer and by the varied and sustained exercise he took, remarkable, and his appetite and digestion had never been better. His age made me suspicious that sclerosis of the cerebral arterioles might be creeping on; but as his heart and pulse did not show the signs of degeneration usual in such cases, and as there was an utter absence of other significant symptoms in the spheres of motion and sensation, I concluded that he was suffering from functional debility of the cortex—an opinion which was confirmed by the good results of the treatment to which he was subjected.

Another case in point is the following:—A gentleman, aged 48, married, had for the last ten years been engaged in active and energetic "Temperance work," which had entailed an enormous amount of mental and physical labour. He had, on the whole, enjoyed very good health, with the exception of occasional attacks of biliousness and diarrhœa. His oratorical powers had always been considered to be of a very high order, and he could speak in public for hours at a time without feeling it to be a strain. Fourteen months before I first saw him, when addressing a large meeting, he suddenly broke down on the platform in the middle of his speech, and was for some time utterly prostrate. He had to give up work, and suffered from vertigo, despondency, irritable temper, restlessness at night, with sudden startings in bed, dull heavy feelings in the head, and considerable loss of physical power; he was unable to read a book or write a letter. After he had been under treatment for some time, he felt so much better that he ventured to address a drawing-room meeting in an informal manner, but found that he was rather disconnected in his remarks, and had to give up after five or six minutes. He gradually, however, recovered all his pristine power, and I recently understood that he had felt able to accept an engagement to be the principal speaker at five large meetings in the country on as many consecutive days.

In the two cases just recorded there was at no time any symptom of actual aphasia, and the loss of oratorical power was part and parcel of a general breakdown of brain-force, without any special affection of the speech-centre. Where actual aphasia occurs, apart from hysterical conditions, or in the course of acute diseases, the outlook is more serious. It may be the first symptom of general paralysis, although the other symptoms present may closely resemble those of failure of brain power.

A merchant, aged 33, but looking much older, had never smoked or drank to excess, had apparently had no syphilis, and an unimportant family history. He had, however, lately had much trouble and anxiety in business, and had felt out of sorts for some time, when one evening while he was playing billiards he suddenly lost his speech. He was perfectly conscious all the time, and understood everything that was said to him. In half an hour he had recovered his language, and appeared to be no worse next day. Since then he had had several such attacks, which came on chiefly after working too hard, or after worry and anxiety. He took a long holiday after the first attack, and had restricted his hours of work; but during the last twelve months other symptoms had made their appearance, showing that the attacks of aphasia were the first symptoms of general paralysis.

While, therefore, aphasia does not occur in encephalasthenia, yet the speech-centre may suffer from undue excitability or loss of control, for many of these patients will talk away about their symptoms for hours if one allows them to do so, and will hardly let the doctor put in a word. Their sentences follow each other with almost lightning-like rapidity, and they seem to be quite unable to stop the machine when once wound up. I would call this condition, which is most trying to others, POLYPHASIA. It existed in a most severe form in the case of the patient described on page 136.

In some persons polyphasia appears to be almost a disease by itself; and it has to my knowledge led to much unhappiness in married life, more especially as those who talk incessantly, often say nothing — "they always talk who never think." A husband wedded to a neurotic wife with polyphasia, is very apt to spend his evenings at the club, or to take a trip to Paris without notice.

An analogous condition occurs with regard to writing; and this I would call POLYGRAPHIA. The patient, on first consulting the doctor, takes from his pocket several closely written sheets of paper which he has prepared previous to the interview, and refers to them all the time he is making his statement. Charcot used to call such a man "L'homme aux petits papiers." The papers are, however, often rather large than small. After the consultation the doctor frequently receives day after day, by post, heaps of written matter which he is expected to peruse and appreciate, but which after some little experience he consigns to the waste-paper basket. The trial is all the greater for the doctor, as the handwriting in such cases is generally very small and crabbed, and therefore difficult to decipher. Moreover, words and letters are frequently left out, while others are put in which are not wanted, and mistakes are made in spelling which greatly astonish the patient when his attention is called to them. In copying a sentence from a letter or a book, the patient is apt to look constantly to the original, being apparently unable to take in more than two or three words at a time.

I have often been able to predict an improvement in the patient's condition by noticing the gradual shrinking of the papers which he brought with him; and when he came at last without any memorandum at all, it was a sign of recovery.

In other cases again there is such difficulty in writing that all correspondence, even that connected with the most necessary business, is apt to languish. A lady told me recently that it was as difficult to her to write a letter as to draw blood out of a stone. It took her sometimes six weeks to finish an ordinary letter. This patient was also given to over-much self-accusation. She thought that everything she did was wicked, silly and foolish. She often burst out crying, as she felt so utterly wretched; and in order to escape from her misery felt compelled to count up to a hundred, or to repeat certain sentences many times over. She also complained that during her period she had a sensation as if there were a burning coal on the right side of her head.

3.—Symptoms in the Sensori-Motor Sphere.

These again may partake of the character of debility or undue excitability. A common symptom in encephalasthenia is a lack of sustained force in all movements; and great fatigue with aching pains in the muscles, after trivial exertion, or even during rest. Walking, standing, or even sitting for any length of time are distressing, and the favourite place of many patients is on a couch or in bed. There is often a sensation of heaviness in all the limbs, the neck and the body. The arms and legs feel like lumps of lead, more especially in the morning.

There may also be a kind of unsettled feeling in the limbs, an inability to rest. The patient cannot sit still in a chair, but has to get up and wander from one room into another, or he cannot bear being indoors, but must go out into the air, etc.

A singular symptom, which I would also refer to instability of force in the sensori-motor-centres, consists of tremors or fibrillary twitches in the muscles. Transitory spasm in the lower portion of the orbicularis of the eyelids is so common that little importance is generally attached to it; but tremor is sometimes seen in the muscles of the arms and legs, or the face, which is apt to cause anxiety. There may be short and rapid jerks of certain muscles or portions of muscles, which resemble those produced by localised faradisation. They are particularly apt to occur in portions of the deltoid and biceps muscles of the arm, but are also seen in the face, neck and back. In other cases there are those more sluggish and crawling muscular twitches which form such a prominent symptom in progressive muscular dystrophy. In several such instances which have come under my notice, the diagnosis of that disease had been made by competent physicians, and an unfavourable prognosis had been given, which caused the greatest anxiety to the patients and their friends. There was, however, a total absence of wasting, and the further course of the affection showed plainly that the twitches were purely functional. It is therefore important to bear in mind that sluggish muscular quiverings do not necessarily point to the development of progressive muscular dystrophy.

A kind of general tremor, which is apt to occur after excitement, and is habitual in some patients in the morning, especially in the hands, is likewise owing to failure of tone in the sensori-motor centres; and the sudden jerking of the whole body, or of one or several limbs, which not unfrequently occurs just when one is on the point of going to sleep, shows undue excitability. Such starts sometimes feel like electric shocks passing from the feet to the head.

The muscles are often well developed, and their examination by the aid of the dynamometer and by electric tests shows no abnormal condition in their structure. Nevertheless, they easily become fatigued by slight efforts, which is shown by the fact that after a few grips of the dynamometer, the index shows greatly reduced numbers when the testing is proceeded with. At the same time the patient may show signs of exhaustion and failure of the heart's action. Such an examination should therefore not be unduly prolonged.

Paresis, paralysis, muscular rigidity, contracture, and atrophy of the muscles, never occur in this neurosis.

Amongst the different forms of altered sensibility, *paræsthesia* is by far the most frequent. A person in health is habitually unconscious of the condition of his body, but in the asthenic there are almost invariably perverted feelings which cause discomfort or distress, and draw the attention of the patient to his morbid state. Thus there may be a feeling of light-headedness, or there is "a blank in the brain," a feeling as if the brain were melting, or as if iced-water were injected into the head, or the head feels as heavy as a lump of lead. The most common complaint with regard to the head, however, is that of pressure and tightness, as if it were in a vice, or as if there was a fifty-pound weight on it, or as if a tight cap were placed over it, etc. Some patients complain of thickness and fulness in the head, or of a dull, stupefying headache.

Sensations in other parts of the body have been described to me as shivers up and down the spine and legs, throbbing, pricking, piercing, stabbing, digging, stinging like a mustard poultice, crawling, creeping, wavy feelings, hot and cold sensations, wandering pains, numbness, etc. One patient had for years felt "as if his head were too heavy for his back, and his back too heavy for the legs." In another case there was so much pain in the legs in walking and standing, that the patient eventually took to walking on crutches. The same man complained of curious tingling sensations in the tongue, which came on every ten minutes, and had similar feelings in the right leg. This and many other distressing sensations which he had made him sometimes feel quite desperate, and suicidal ideas then flitted across his mind. A lady complained of a peculiar sensation in her side which nearly drove her mad, and also of constant chills on the top of the right shoulder.

A married lady, aged 43, who was one of thirteen children, twelve of whom had died in infancy, had had one child and several miscarriages, and had been in tolerable health until about six months ago, when she "got into a temper," and banged the door, which seemed to give her a jar through her system. Since then she had been excessively sensitive all over; her head and nape of neck were so tender that she could not bear to be touched, or have her hair combed or brushed; she could not do anything with her hands for the same reason, and her legs were so tender that she was quite unable to walk or stand. She refused to have the knee-jerk examined, as it would hurt her too much. She did not dare to turn her head round, for the same reason, and was excessively sensitive to noise. *It hurt her to hear herself speak*, and when she did so she had a sensation as if her head was opened. She had been fond of singing and playing, but could do neither now. She could not read or write a letter, and did not dare to look at a book or a paper.

A clerk, aged 33, married, had been on the whole in good health, until about twelve months ago, when he began to complain of headache, chiefly temporal, and heaviness and pressure on the head. He found that he was much more easily upset by trifles than formerly. The principal thing, however, which troubled him was a curious sensation in his right leg. It seemed to him as if there were a cold draught blowing on the right instep, and this sensation gradually proceeded upwards until it settled in the right thigh. Whenever he was excited or worried, this sensation in the leg increased, and it appeared to him "as if his brain were in his leg." He had occasionally had similar sensations in the right arm, and some difficulty in writing.

The different kinds of hyperæsthesia and paræsthesia met with in this neurosis are therefore seen to be almost as varied and numerous as those found in locomotor ataxy. Although I have not met with actual lightning pains, different forms of pain may be felt in all parts of the body. A favourite seat of it is in the intercostal spaces, where it is often associated with cardiac symptoms, and in the cervical and lumbar spine. Backache or rhachialgia may be superficial or deep, and is described as aching, burning, stabbing, or simple soreness. It is generally rendered worse by contact, pressure, and active or passive movements, more especially by walking, stooping, and bending forwards, and is often associated with great tenderness in the vertebræ.

In some cases there is so much pain produced by any kind of movement that the patient takes to the recumbent position for good, and remains motionless, like a fakir, for years consecutively. Möbius[143] has called this condition "*akinesia algera*" "painful immobility," and is inclined to consider it as a psychosis, a form of paranoia. Longard,[144] on the other hand, believes it to be identical with what used to be described as "spinal irritation," while Erb,[145] who has seen a highly characteristic instance of it, speaks of his patient as "mentally highly gifted, perfectly clear-headed and amiable," so that the idea of a psychosis could not be entertained. In most cases of this kind there were noticed other symptoms of failure of brain power, such as insomnia, depression, incapacity for mental work, fulness and pressure in the head, and distressing sensations in the spine. The cause appeared to be generally mental over-strain, in persons neurotically predisposed. Neftel[146] has described a similar condition as atremia.

Most authors are agreed that this akinesia is of a functional character. It does not appear to be a special pathological entity, but rather one symptom amongst many others, and which may occur in persons subject to encephalasthenia as well as in others who are mentally afflicted, or on the point of becoming so, but not in hysteria and hypochondriasis. I have seen a lady, aged 28, who had not only been in bed for six years, on account of the intense pain which was caused by the slightest movement, but who had actually ordered her nurse to strap her up as tightly as possible on a water bed, so as to reduce any change of position to a minimum. Her relations considered her deranged on this account, but her intellect was keen, her reasoning powers considerable, and there was no trace of insane delusions nor of hysteria.

Such patients may, indeed, say with Schopenhauer that "pain is the positive element in life," and will hardly agree with Sterling, who asserts that "pain has its own noble joy, when it kindles a strong consciousness of life, before stagnant and torpid!"

Simple hyperæsthesia is common, so that an ordinary touch, instead of producing the feeling of contact, is unpleasant and painful. We also meet with tenderness on cranial percussion, which is in some cases strictly confined to a special area, or to one hemisphere.

On the other hand, there is never any real anæsthesia or analgesia, no delayed sensation, and no loss of the senses of temperature, locality, or pressure, such as are seen in hysteria, tabes, and other diseases. This constitutes an important difference which may be frequently utilised for diagnosis.

It appears to me indisputable that the paræsthesiæ and hyperæsthesiæ met with in this neurosis must be of cortical origin. Singularly enough, there appears to be much doubt amongst many observers whether peripheral pain may be elicited by central affections. It is true that experimental physiology cannot teach us anything on this point, as it can only show that some parts of the brain and spinal cord are sensitive to painful stimulants, but not whether central irritation is felt as pain in the periphery. While, therefore, the production of pain by irritation of the terminations of the afferent nerves, as well as of the nerve-trunks themselves and their roots, is generally admitted, the possibility of the causation of pain by affections of the brain and spinal cord has been questioned. Möbius[140] denies such a possibility altogether, and in Nothnagel's classical work on localisation in brain disease there is no information on this point, except the remark that pain in the limbs has been noticed in some cases of disease of the pons. Yet certain clinical facts show with absolute certainty that peripheral pain may be produced by cortical irritation. Thus we find a painful aura in not a few epileptics; such as violent pain shooting through the head, or limited to one part of the head, in which after the fit is over tenderness may be felt; a feeling as if an arm were going to break, or a pain starting in the foot, going up the leg, and then invading other parts of the body, without any spasm; or a stabbing pain in the chest, the epigastrium, etc.

Other sensations, such as numbness, tingling, burning, an icy feeling, etc., are likewise not uncommon as auræ. These facts alone are sufficient to refute the theory started by Möbius. An interesting case, in which a focal lesion of the thalamus opticus caused the most agonising pain from the very commencement of the attack, has been described by Edinger.[147] His patient was a woman, aged 48, who had an attack of right hemiplegia accompanied with such awful pain and hyperæsthesia that she could not bear the right arm and leg to be touched, and hypodermic injections of morphine were required to relieve her. As it soon became necessary to use very large doses, true morphinism was presently induced. The right eye was also the seat of the most terrible agony. After a time morphine ceased to do good, and she became so desperate with pain that she made several unsuccessful attempts on her life by throttling and stabbing. At last she killed herself by drinking, in the temporary absence of the nurse, a mixture of chromic and sulphuric acids, which was in use for charging a galvanic battery.

The severe pains which are apt to occur in hypochondriasis and hysteria, can likewise only be explained by assuming a cortical origin for them. More will be said on this in the chapter on diagnosis.

Vertigo.

Giddiness is very commonly complained of, and may come on in paroxysms or be incessantly present. Vertigo is a form of paræsthesia, viz., the sensation of apparent motion. Sometimes the patient feels as if he were turning about in all directions, or as if his head were turning, or as if he were standing on the deck of a ship during a gale, or as if surrounding objects were spinning round, etc. It is generally made worse by standing or walking, and relieved by the horizontal position. In those who are predisposed, it may be brought on by very slight causes, such as by smoking a few whiffs of a cigarette, by taking half a glass of claret, by playing a game of billiards, by being in a hot room, etc. Vertigo is generally believed to occur *a stomacho læso*, or from alterations of pressure of the endolymph in the semi-circular canals, or from cerebellar disease. It may, however, likewise be owing to undue excitability of the pre-frontal area, of the optic lobes, and other portions of the brain; and also to arterio-capillary sclerosis. Few symptoms are so apt to unsettle the mental balance of the patient as vertigo, which is often associated with such feelings of dread, that the patient feels inclined "to throw up the sponge."

The Sensibility of the Viscera

is likewise altered. This is chiefly seen with regard to the feelings of hunger and thirst. There may be loss of appetite, but more frequently the patient is actually ravenous, with craving for food shortly after a good meal. There is also a great inclination for excess in alcoholic beverages, which lift the load from troubled minds for the time being, by deadening the numerous wretched sensations of which such persons are victims. A feeling of dissatisfaction may also occur after urinating, defæcating, and other forms of action.

The Reflexes.

The superficial reflexes are generally increased where there is any form of hyperæsthesia. This is more particularly seen in the sole of the foot; but the cremasteric, abdominal and gluteal reflexes are also found exaggerated. The tendon reflexes may be normal, sluggish, or exaggerated. They are sluggish in cases where there is great failure of nutrition. The knee-jerk, however, is never absent, as in tabes, neuritis, some forms of diabetes, etc. In a few cases, however, it was so sluggish that I found it necessary to use Jendrassik's manipulation in order to elicit it. Exaggeration of the tendon reflexes is far more common; and this has occasionally led to an erroneous diagnosis, brain disease or spastic spinal paralysis having been presumed to exist. In some cases I have seen an oddity in the response when the patellar tendon was tapped, so that the leg was thrown, not forwards, but sideways. These cases were of a particularly severe character. Eliciting the knee-jerk sometimes causes great distress to the patient; and the tap should therefore never be forcible. The periosteal reflexes and the mechanical excitability of the nerves and muscles, are frequently exaggerated; and the pupillary reflex is invariably present.

4.—Symptoms in the Sensory Centres.

(*a.*) *The Visual Centre.*

Cases in which complaints of an alteration in the visual impressions are made are not uncommon. Objects may be seen in a different light, everything may be dark or dazzling, and the faces of people and the aspect of a landscape may appear unnatural. There is a tendency to temporary loss or dimness of sight after reading for some little time, and a difficulty in fixing objects, which is often accompanied with headache and giddiness. A walk through a picture gallery is apt to intensify such symptoms. There may also be photophobia to such an extent that the patient keeps habitually to a dark room. All these symptoms are evidently referable to undue excitability or asthenia in the visual centre, for a careful examination of the eyes reveals nothing abnormal.

A single lady, aged 27, contracted influenza and would not go to bed, because the whole family had it, and she felt it her duty to nurse them. In a few days, however, she was so utterly prostrate that she could not keep up any longer, and had to remain three weeks in bed. Ever since then she had been in a state of intense nervousness and mental depression, from which nothing could rouse her. She spent a month at the seaside, but without deriving any benefit from it. When I first saw her, six months after the attack, she complained of restless nights, with horrible dreams, incessant attacks of giddiness and headache, while occasionally her head gave a sudden twist, which frightened her so much that she nearly fainted. She had cramps, numbness, and pins-and-needles in the limbs, and great difficulty in walking. She felt, however, chiefly alarmed by a peculiar change in her sight. Sometimes everything appeared light, at other times dark; any object that she looked at appeared to change when she fixed it, small objects becoming large, and *vice versâ*. She often saw stars, sparks, and other luminous appearances flying about, and when this happened her eyes watered a good deal. An ophthalmoscopic examination showed the fundus of the eyes to be in a normal condition, and the sight was fairly good. There was extreme tenderness on cranial percussion, more especially over the occipital lobe: and eliciting the knee-jerk in the ordinary manner sent a thrill through her whole system.

Limitation of the visual field, which is so common in hysteria, is rare in the neurosis now under consideration, and if found, appears to be owing to fatigue induced by a prolonged examination. Double vision is rare and temporary, and owing to fatigue of some individual ocular muscle.

(*b.*) *The Auditory Centre.*

Tinnitus, or subjective noises in the head and ears, is a very common occurrence in encephalasthenia. There may be also undue sensitiveness to noise, such as slamming a door, the whistle of an engine, or, worst of all, a street-organ. Hyperæsthesia of the auditory centre with regard to the latter infliction is commonly understood to have killed Professor Babbage, the inventor of the calculation machine, and Leech, that delightful contributor to the pages of *Punch*.

Hallucinations of hearing are frequent in the insane, and may assume the dangerous form of hearing voices which command the patient to carry out certain acts. Such and similar delusions are generally considered to be certain signs of mental derangement; but the society for psychical research has found that hallucinations and other delusions occur in 9 per cent. of healthy persons about whom inquiry has been made, and who certainly could not be considered insane.

I have seen a case in which auditory hallucinations occurred in a man, aged 38, whose intellect and judgment were perfectly sound. One morning he came to me in great distress, expressing the apprehension that he was going to become insane, as for some days past he had, without any apparent cause, heard voices behind his back, calling him names and speaking in a derogatory manner about his position and his state of health; and he appeared to be quite worn out by anxiety on this account. I treated him with an application of the constant current to the portions of the scalp corresponding to the auditory centres, for five minutes (two milliampères). Immediately after the application the auditory hyperæsthesia was subdued, and the hallucinations had not returned when I saw the patient again two years afterwards.

In another case, that of a teacher, aged 32, who was, however, decidedly on "the borderland," there were in addition to many other symptoms, auditory hallucinations of "rappings and knockings all night." The patient felt so disturbed by these imaginary sounds that he changed his lodgings four times in the space of a fortnight on that account. He had also the delusion that he was going to be accused of a crime, was surrounded by detectives, and that his own mother would bring him into a court of law. At the same time he was quite rational on other subjects. After a few weeks' treatment he lost the delusions of persecution as well as the auditory hallucinations, and eventually made a perfect recovery from all his other symptoms of failure of brain power.

(*c.*) *The Centres of Smell and Taste.*

Olfactory hyperæsthesia is seen in certain forms of insanity, hysteria, tabes, and as a premonitory sign of epileptic attacks, and arises from undue excitability of the nerve cells in the olfactory centres. Hyperosmia has this peculiarity, that only unpleasant smells are perceived. There is never an impression of nice scents or sweet-smelling flowers, but rather that of rotten eggs, fæcal matters, and every other kind of abomination. A similar hyperæsthesia may occur in cases of the neurosis now under consideration, but seems to be very rare.

Hemi-anosmia occurs in hysterical women as part and parcel of the hemi-anæsthesia from which they so frequently suffer. Anosmia may be owing to olfactory neuritis, of which I have described a unique case elsewhere,[56] or to accidental injury and rupture of the olfactory nerves; but I have never seen anosmia in failure of brain-power.

Gustatory parœsthesia, or hallucinations of taste, occur in the insane, and may suggest to the patient that his food has been poisoned, leading to refusal of food. The same is seen in the later stages of tabes, when the patient imagines that rotten eggs, sulphur, phosphorus, mineral acids, vermin-killer, mud, fæces, arsenic, dynamite, and verdigris are put into his food. Somewhat analogous symptoms may occur in simply asthenic patients, but their complaints on this point are not of such a serious kind as those of the insane or the tabetic. Their food appears to them simply too salt, or too bitter, or insipid, but they do not imagine that poisons are mixed with it.

Symptoms of asthenia or undue excitability of the *centrum ovale*, *corona radiata*, and *internal capsule* (p. 22) do not appear to occur in the neurosis which we are now considering.

5.—The Central Ganglia,

however, may show debility in their automatic action, so that such actions as walking, talking, writing, dressing, dancing, etc., which in health require no conscious effort, demand the full attention of the cortex.

6.—Symptoms in the Sphere of the Emotional Centres.

The emotional centres being situated in the mid-brain, I am inclined to ascribe the various feelings of fear, terror, alarm and panic, which are such a striking feature in the clinical aspect of asthenic patients, to undue excitability of the optic lobes and the pons. Indeed, most of these unfortunate persons suffer from feelings of despair, hopelessness, want of confidence in their powers, vague alarm, timidity in society, or dread of being alone: they are afraid of going out into a large place, or of being shut up in a narrow one: some are unable to stay indoors; others apprehend the impending invasion or the actual presence of certain diseases, or that the house is likely to be set on fire; some again fear they cannot walk, or that everyone is looking at them, or that there is a great difference between their right and left side. "Fear," says Defoe, "that blind, useless passion, throws us into the vapours; it bewilders our understandings and sets the imagination at work to form a thousand terrible things that perhaps may never happen." Some persons feel the temptation to jump out of an upper-floor window, or to throw themselves down from a great height, from the top of steeples, columns, or gallery seats in a theatre, or there is the fear to be obliged to cut one's throat on seeing a knife, or to kill one's children, etc. Such morbid fears and emotions are of the most distressing character, and embitter for years the lives of many persons, who often find no sympathy either from friends or doctors.

A lady told me some time ago that she would rather have another confinement than these wretched feelings, and that pain was nothing when compared with them. Another patient expressed himself to the effect that "his suffering was unparalleled and unsurpassable. No description could give the faintest idea of the misery and distress from which he had suffered for the last thirty years. It would take a whole year to describe it; and not one of the numerous doctors whom he had consulted had formed the least conception of his condition, which was darkness that 'might be felt,'" etc. Indeed the sensations which are experienced are sometimes so terrible that the patient loses all control over himself, throws himself on the floor, kicks, bites, shouts that he is going to die, vomits, emits his excreta, but does not lose his consciousness, and presently recovers his mental balance, at least to some extent.

A gentleman, aged 41, married, had, when 21 years of age, a sudden attack of intense depression, with horrible feelings, which were quite overpowering. The depression was very severe and indeed almost unbearable for two or three weeks, when he gradually got better, but it never left him entirely. When 30, he had a similar attack, immediately after having engaged himself to be married. This also abated, and the last attack came on about six months ago. In this, morbid fears seemed to play the principal part. When reading a book or a paper, these fears suddenly intruded on him, and he could not divert his attention from them. He feared that he must do harm to somebody or take his own life. It seemed to him on these occasions "as if he had suddenly become poisoned."

An engineer, aged 23, single, had a bad history. His father had late in life taken to drinking heavily, and died of paralysis; his mother died, rather young, of consumption, and there had been paralysis and chorea in other near relations. When he was only a boy the whole responsibility of his father's business was thrown upon him, so that he was obliged to work night and day. When 16 years of age he first began to have feelings of panic and alarm, and was taken with headache, vertigo, and morbid blushing on the slightest occasion. He feared that he was becoming insane, the word "mad" constantly rang in his ears, and he began to imagine absurd things; for instance, that a friend who was alive was really dead; he kept asking himself whether he had a head or not, and was frequently twitching all over. He had been in this condition for seven years when he first came to see me, and said that "his poor brain could not stand this terrible strain any longer." There was exaggeration of the knee-jerk and phosphaturia, but no other objective symptoms, and the patient eventually made a good recovery.

A single lady, aged 33, had always been very nervous from childhood, and had twitches in her face. Her father had been a very delicate man, and died in an asylum. Her nervousness had greatly increased during the last ten years. She complained of specks before her eyes, and flashes of lightning with vivid colours when in bed. She had ringing noises in the ears, with giddy feelings, and a wearying scraping feeling on the crown of the head. She was frequently subject to fits of depression. When travelling by rail she felt that she must jump out of the train; her head and heart got into such a state that she could not control herself, and she was so introspective that she began to unpack her luggage or take her dress off, simply in order to do something, and to take attention off herself. When on a pier at the seaside she felt that she must jump over, got into a perspiration, and her face was white with fright. In the night she had to hold on to her bed and pray for help to lie still, and not get up to take her life. After such attacks she was very weak and ill. When walking in the country and passing a sheet of water she feared that she must jump into it; or when standing on a railway station, that she must throw herself in front of a train. The autumn used to be her worst time, but she now was thus all the year round. She could not read a book without her head getting mixed up in a few minutes, felt thick-headed, and forgot nearly everything she had to do. When going out for some purpose, she would discover all at once that she had quite forgotten what she intended to do; and often found herself in quite a different place from where she wanted to go. Any noise was apt to drive her half crazy; children quarrelling or even talking, shutting a door, or suddenly hearing a musical instrument played, was horrible to her. She could not go out to luncheon, or a concert, or to visit friends, as when in company her head at once got worse, and the scraping feeling on it became quite overwhelming. She had struggled and fought her hardest against these fearful sensations, but without avail, and felt that she could not bear them any longer.

A large number of new words have been coined to designate these different kinds of fear, but only a few of them have found acceptance. Westphal, who is responsible for the beginning of what has, with some writers, almost become a mania, was the first to describe *agoraphobia*, or the fear of open places, which is a highly interesting condition. A patient when obliged to go out of doors, or to cross a square or an empty street, is suddenly seized by such a feeling of dread that he stands fixed, and is unable to move. He has therefore to call for another person's arm to support him, and then suddenly recovers his control, and walks along quite easily. In a somewhat slighter degree of the affection, the patient can manage to get along by keeping very close to the houses, or walking behind a cart or carriage, or by the simple consciousness that somebody is near him; but the fear is not relieved by reasoning with himself, and thinking that it is after all nothing but nonsense. One of my patients graphically described his condition by saying that, as soon as he left his house "he felt as if toppling over, and when people saw him sprawling about, they thought that he was tipsy." Another patient found it impossible to walk between hedges, was obliged to avoid certain streets, feared the sun, was happiest when it rained heavily and he was under cover; he liked fogs and darkness, and a bright day made him miserable.

Limitation of the visual field is apt to occur after an attack of agoraphobia, but generally vanishes as the patient recovers from the fit; and the visual field then resumes its normal extent. I have known the attack of agoraphobia to end with vomiting, which did not appear to depend upon anything the patient might have eaten, but from sheer undue excitability of the gastro-intestinal centre in the bulb. Indeed, such sickness sometimes occurs on an empty stomach.

There are cases in which the *reverse of agoraphobia* exists. This condition is rare, and does not appear to have as yet been described; but I do not intend to coin a new word for it. While in the fear of open places the patient craves for some one to walk with him, instances are on the other hand met with where there is uncontrollable fear of walking with others:—

A country gentleman, aged 45, married, who had been smoking heavily for many years past, and also committed other excesses, but whose family history was good, had for some time past been nervous in various ways. Two years ago a fresh and most distressing trouble appeared, for which he consulted me more particularly. It was that he found it impossible to walk in the street or in country roads with *any one walking by his side*. This was the case even with his wife and children, but much more so with friends or strangers. If any one met him in the street and said, "I will walk a little way with you," the patient was obliged to stop until his friend was gone, putting him off by various excuses, or to jump into a cab. If he forced himself to walk along with any one, he after a few steps burst out into a cold sweat, and felt so utterly wretched that he was obliged to stop, for fear of having a fit. If he was walking in the country, and heard somebody coming the same way with him, he was obliged to stop until the man had passed him. On account of this trouble he had constantly to find excuses to put his friends off, and had been obliged to give up playing lawn tennis, because people, after the game was over, insisted on accompanying him home. Reasoning about it he had found utterly useless. Except for this trouble he had not much to complain of, and was of a cheerful disposition.

Other forms of fear have been described by Beard and other observers, and designated with more or less fearfully coined words, such as *acrophobia*, the fear of heights (Verga); *amaxophobia*, a morbid fear of being in a waggon or a cart. This is not uncommon. I happen to know a lady who has an uncontrollable dread of being in a hansom cab, while she does not mind being in any other kind of vehicle. *Anthropophobia* is the fear of being with other persons, aversion to society; *astrophobia*, the dread of thunderstorms, fear of lightning; *atremia* (Neftel), the fear of getting out of bed; *batophobia* is synonymous with acrophobia; *belonephobia* (Charcot and Magnan), a horror of pins or other metallic objects; *claustrophobia* (Ball, Raggi), the fear of being in a narrow, close place, inability to stay indoors, with inclination to open the door and windows, or to run away altogether. Harry Campbell traces this symptom to an originally existing craving for freedom of the movements of the limbs and respiration, so that anything which engenders a sense of captivity is highly repugnant to the individual, and tends to lead to the direst panic. The claustrophobiac has therefore a morbid fear of suffocation and captivity, and delights in wide open spaces in the country, with not even a tree by, because they suggest the opposite condition. I have known other persons who preferred being in a dark room, and covered their head with their hands while there. *Clithrophobia* is another term for claustrophobia; *gynephobia* is a fear of women (it should etymologically be gynæcophobia); *kleptophobia* is a fear of being obliged to steal; *monophobia* is the dread of being alone, more especially of travelling alone, while there is no difficulty in travelling in company with another person; such patients therefore require a constant companion. I have seen this condition in an American journalist, in whom it had come on through excitement and overstrain, and was combined with polyphasia. *Mysophobia* (Hammond) is the fear of dirt, defilement or contamination.

Such persons will wash their hands two hundred times a day. I have known a lady who brushed her teeth forty or fifty times a day, even getting out of bed several times for that purpose; others constantly brush their clothes, holding them out of the window so that the room may not be defiled. A lady whom I know, spends the better part of the day in cleaning the ornaments in her drawing-room, although they are perfectly clean, and apologises to visitors on account of the ornaments being dirty.

One of the most distressing cases of this kind which I have seen, was that of a merchant, aged 41, married, who had suffered from "syphilis insontium" as a boy, when ten years old. He had had throat and skin affections for two years, and was during the whole of that time unable to speak except in a whisper. He eventually recovered from this, but about five years ago was seized by a strange fear that people whom he met in the street or elsewhere, who might have a few spots on their faces, were infected with something or another, and that it was necessary for him constantly to wash his hands to escape infection. He washed his hands at least thirty times a day, but often more frequently; and believing his gloves to be infected, when somebody shook hands with him, felt obliged to burn them. He had burnt hundreds of gloves in a month, from fear that they were infected and might poison him. Before sitting down on a chair, he was obliged to look at it to see whether it was not infected. He also felt obliged after washing his hands to hold them up for some time, and could only gradually let them down.

Oikophobia is the fear of home; *onomatomania* (Charcot and Magnan) is an agonising search for a particular word, which the patient does not succeed in finding; *pantophobia* is the fear of everything; *pathophobia* is the fear of getting certain diseases; *phobophobia* is the fear of having an attack of fear; *sidero-dromophobia* (Rigler), a fear existing in persons employed on railways, more especially in engine-drivers, with morbid disinclination for work; *topophobia*, the dread of certain places, of going to any locality, for instance to church, or some other place where the first symptoms of illness commenced, of being unable to walk in a straight line to a certain place, etc.; *toxiphobia* (Cameron) is the fear of being poisoned; and finally, *zoophobia* is the fear of animals, more especially beetles, mice, rats, spiders, etc.

Many other forms of morbid and groundless fears are habitually felt by nervous persons, and to which, fortunately, as yet no semi-barbaric Greek names have been attached.

Thus the newly-fledged medical practitioner, after writing a prescription, will be persecuted by the idea that he has written down too large a dose, or left out the word "dilutum"; a man who has written and posted several letters will be seized by the fear that he has put letters into the wrong envelopes, and will picture to himself for hours the complications which might arise if a certain person were to get a letter not intended for him, etc. Fears of all kinds may exist separately or together with other symptoms, and do not occur habitually in structural diseases of the brain or other portions of the nervous system, so that they may, in doubtful cases, be utilized for diagnosis.

The existence of asthenia in the *pituitary body* and the *cerebellum* cannot be diagnosed at present, as the symptoms which might be expected to occur in such cases, such as depression, apathy, giddiness, difficulty in walking, etc., may likewise be seen when the neurosis affects other portions of the brain; and a definite localisation is thereby rendered impossible.

7.—Bulbar Symptoms.

Here we are on much firmer ground, as the functions of the medulla oblongata are much better known, and more sharply localised than those of the cerebellum. Signs of debility or undue excitability in the different centres of the bulb are indeed of very common occurrence in the neurosis under consideration. Sometimes only one centre suffers, while in other cases several are affected simultaneously.

(1.) The Cardiac Centre.

Signs showing failure of power in the cardiac centre are, as usual, either those of undue excitability, or of paresis, with liability to alternation.

a. Palpitations. Acceleration of the heart's action is one of the commonest occurrences of daily life under the influence of emotions or increased physical exertion; but in encephalasthenia palpitations are induced by insufficient causes, which have no influence on healthy persons, such as the receipt of a letter or telegram, or any little annoyance or excitement. They may come on after meals, on going to bed, on awaking in the morning, from sleeping on the left side, from smoking, drinking tea, coffee, wine, spirits, etc.

Palpitations may be subjective, or perceptible to the hand and ear. They are sometimes so distressing to the patient as to cause the fear of impending death; and are often accompanied with pain in the cardiac region, and thrilling sensations in the arms and fingers. The pulse is quick, up to 100 or more, showing irritation of the accelerator centre, and may be of medium or high tension. The attack of palpitations may last for a few minutes or some hours, and is often followed by prostration.

A clergyman, aged 29, single, had long suffered from extreme nervousness. He felt anxious about the least thing, did not care about society, and was subject to what he called "fainting fits," in which he did not actually faint away, but was very near doing so. He suffered from profuse perspiration in the hands and feet, so that he wetted everything he touched, and was subject to palpitations, and "catchings of breath." The pulse was of low tension, but regular (80). During a service he was always subject to fear that he might have an attack:

the heart then began to beat violently, "the breath caught," and he read like one panting for air, while the perspiration was streaming away from him. This, however, was only while reading the lessons; when he got up to preach and warmed to his subject, these fearful feelings left him, and he felt confident of his powers. He also complained of a constant singing noise in the ears. The urine was strongly phosphatic. There was no heart disease. In this case the sudorific and respiratory centre suffered together with the cardiac.

b. Asthenia. Simple failure of power also occurs in the cardiac centre without palpitations. The pulse is of low tension, and indeed sometimes almost imperceptible. The rate at which it beats may be normal, or accelerated. I have seen several interesting cases of this condition, in which the principal symptoms were those of anæmia of the brain. The asthenia of the cardiac centres appeared to be in these cases combined with spasm of the vasomotor centre, which also leads to cerebral anæmia.

One of these patients was a professor at a University, aged 29, married, without neurotic inheritance, and of temperate habits. Three years ago he had had a great deal of illness in his family; his wife had a miscarriage under peculiarly ghastly circumstances, and his mother died. Some months after this he had, when abroad, an attack of thorough nervous prostration, and was unable to do anything for about three months. After this he went to Greece, where he lived for two months almost entirely out of doors, and got better. From there he went to Florence to pursue his studies, and became ill again. He was chiefly troubled by a feeling of intense pressure on the head, which extended all the way down the spine. His face looked pinched, he suffered from dyspepsia, and could not do anything. Later on he had, while at a theatre, a sudden feeling as if his head were wrenched, with attacks of faintness and prostration. There was constant giddiness; he walked as if he were on board ship in a gale of wind, and dreamt at night that he was falling down from some high place. Position had a great influence, as when lying down he often felt quite comfortable, but was seized by vertigo and sick feelings as soon as he got up. Once he fell on the floor as if he had been shot, but without losing consciousness for an instant. When I first saw him he was pale and thin, the tongue had a yellow fur; the pulse was barely perceptible, the heart's sounds healthy, but exceedingly weak. The principal complaint was of intense debility and giddiness, chiefly when walking or standing, and of utter inability to work. There was cranial and spinal tenderness, and the deep reflexes were exaggerated. The urine was neutral, had a density of 1008, and contained a considerable excess of phosphates. He had nasty sensations in the occiput, which extended from thence into the upper part of the head; these were constant, but increased when thinking or talking seriously; it became sometimes so bad in the middle of a sentence that he had to finish with a lame and impotent conclusion. There was also a dull ache in the small of the back, a distressed feeling in the pit of the stomach, nausea, with occasional attacks of vomiting, while every physical exertion, however slight, was followed by an entirely disproportionate amount of fatigue. Eating relieved his distressed feelings generally, but if they were bad, all appetite disappeared. Under electrical and other treatment for improving the condition of the cardiac and vasomotor centres, the patient got much better; yet some time afterwards he still felt inability to walk or stand for any length of time. The trouble in the head was, however, much less, and he was able to work. The attacks of giddiness, confusion of thought and general lowness of tone throughout the system, were less frequent, and yielded more readily; but he was still unable to lecture while standing, or to walk more than half-an-hour. He could go more into society, and did his literary work very well. After several "ups and downs," the body weight began to increase, and the patient could walk without discomfiture or fatigue. In proportion to this his health and spirits rose; he could deliver his lectures, standing for an hour or more; he had none of those violent attacks of prostration as formerly, no giddiness or sense of effort in walking, could converse freely while standing, and sit at table without discomfort, as well as enjoy a performance at the theatre. He has now been quite well for more than ten years, and has undertaken much additional work without any ill effects whatever.

I found very nearly the same symptoms in another University professor, aged 45, single, who had for more than six years overworked himself greatly, and often been on the verge of collapse, from exhaustion and imperfect sleep. He lost power in his legs, had to lean against a table while lecturing, and the legs became numb and chilly. To this was presently added an attack of polyuria, and he felt so chilly that when sitting in a warm room he had to cover his legs with a rug. The pulse was 72, small, never intermittent, but weak, and felt like a thread. There was no heart disease or any other organic affection.

c. Tachycardia, or an unduly rapid action of the heart, is not unfrequently found as a symptom of encephalasthenia. I have seen several cases in which it was a sequel of influenza. It may be owing to pericarditis, or to degeneration of the muscular wall of the heart, etc., but is in many cases purely neurotic. Klemperer has related a case in which the mere suggestion of digitalis did good. A medicine labelled "The digitalis and orange peel mixture" was given, but no digitalis was put into it; yet it cut short a bad attack of tachycardia all the same. This case had probably a hysterical base.

Tachycardia may be paroxysmal or habitual. In the paroxysmal form, which Bouveret has called the benign variety, the pulse varies between 120 and 160; while in habitual or malignant tachycardia, the pulse-rate is never normal, and may go up to 200 beats and more. In the former there may be an absence of all distress and discomfort, and life may go on for years, with "ups and downs," without disabling the patient, while in the latter form the nervous system of the heart is more profoundly disorganised. The patient is pale, thin, restless, has dyspnœa and polyuria, and eventually succumbs to an attack after great sufferings. In some such cases no post-mortem changes have been found, while in others fatty degeneration of the muscular wall of the heart has been discovered.

Tachycardia arises either from an unduly excited state of the accelerator, or a low tone of the pneumogastric inhibitory centre. It is often difficult to diagnose between these two conditions, except *ex nocentibus et juvantibus.* Where the paroxysm is owing to undue excitability of the accelerator centre, it is generally cut short by a dose of morphine; but that drug is useless when the inhibitory centre is depressed. The latter condition is best treated by digitalis, strophanthus, and nitroglycerine, and has in some cases yielded to pressure on the pneumogastric nerve in the neck, as well as to the constant current applied *secundum artem.* Even where there is heart disease, some nervous trouble has often to act as an exciting cause before tachycardia is developed.

A married lady, aged 25, who had had rheumatic fever six years ago, and had since then shown evidence of mitral incompetence, had never had much trouble with her heart until a short time ago, when she had much vexation and anxiety in consequence of her brother having taken to drinking. She then developed periodical attacks of tachycardia, which generally commenced about 4 p.m. She felt faint, frightened and giddy, and thought that she was going to die; she had severe palpitations, and the pulse went up to 160 and more. Her hands were covered with clammy sweat, she could not lie down, was unable to sleep, and felt quite worn out in the morning. She rallied well as the day went on, until another attack came on in the afternoon. In this case the constant current applied to the pneumogastric nerve sent the pulse down in a short time from 140 to 92.

d. Bradycardia, or an unduly slow action of the heart, is generally owing to irritation of the pneumogastric centre, and is not very common in this neurosis. The pulse must be down to 40 or less in order to constitute bradycardia. When purely neurotic, it is compatible with good health and longevity.

e. Arythmia, or irregularity in the heart's action, is more frequent than bradycardia. There are different forms of it. Thus we find the *intermittent* pulse, where a beat is occasionally left out; the *alternating* pulse, where a strong pulse is succeeded by a weak one; and the *twin-pulse* (pulsus bigeminus), which was discovered by Traube, and found by him to be owing to paresis of the inhibitory cardiac centre; in this there are two beats and then a pause. Finally there may be absolute *anarchy*, or riotous action of the heart. Some neurotics have entirely different rates of pulsation at different times of the day. The trouble is often associated with other symptoms of failure of brain-power, such as nervous dyspepsia and spasmodic asthma. It is made much worse when the patient's attention is directed to it, and he keeps feeling and counting his pulse habitually.

f. Pseudo-angina pectoris.—While true angina pectoris occurs more frequently in men than in women, and at a somewhat advanced age, viz., between 50 and 60, when arterio-sclerosis is apt to set in, the pseudo-angina of encephalasthenia is much more frequent in women, and habitually occurs at a much earlier age, even before 20. The symptoms of the two conditions are likewise different, for while a dull and aching pressure behind the sternum is one of the most marked symptoms of true angina, this is absent in pseudo-angina, in which latter a stabbing pain is usually felt below the apex. On the other hand, shooting pains, radiating into the left shoulder and arm, are common in both conditions. True angina is generally the first symptom of heart trouble, while pseudo-angina is often preceded by tachycardia or bradycardia.

In most cases where the cardiac centres appear to be suffering in some such way as I have just described, neither inspection of the thorax, nor auscultation and percussion, show the existence of any valvular or other organic trouble in the heart. The rate of pulsation is generally normal, or only slightly increased, during times which are free from attacks. Nevertheless the action of the cardiac muscle is habitually feeble; the first sound is weak, and apt to be accompanied by a soft, blowing murmur, and the tension of the pulse is low.

(2.) The Vasomotor Centre

is in health in a state of moderate tonic excitement, but may in encephalasthenia be unduly excitable, causing spasmodic contraction of the arteries, with increase of blood pressure; or there may be paresis, when the arteries become relaxed, and the blood pressure falls.

a. In *spasm* of this centre the skin is blanched, the extremities are cold, there is a feeling of emptiness in the head, and the patient feels as if he were going to faint or to die. He appears collapsed, the eyes are sunken into their orbits, there is a cold clammy sweat on the brow, the fingers appear dead, and there is numbness and "pins and needles" in the extremities. The abnormal feeling of cold sometimes continues all day long, and prevents sleep, or awakens the patient after a short sleep. Sometimes there is actual loss of consciousness, commonly called a "fainting fit."

A solicitor's clerk, aged 24, single, complained of constantly feeling low and depressed, lethargic, indifferent to his work, and subject to faint feelings, especially when he had some business to transact. If he had to make a statement of some kind in a Court of Justice he very nearly fainted away, would sink into a chair, and "sleep it off." He was evidently thoroughly up to the mark intellectually and had no lack of decision; but the circulation of the blood appeared to be often on the point of ceasing altogether. His hands and feet were habitually cold and clammy, the heart's sounds almost inaudible, and the pulse thread-like. He looked anæmic, but was not really so, the number of red blood-cells being normal. He was generally much worse after meals. He recovered by electrical treatment of the vasomotor centre.

b. Paresis of this centre leads to relaxation of the arterial walls, and causes reddening, especially of the head, neck, ears, and limbs, with increased heat. This state is more paroxysmal than permanent. Sudden vasomotor paresis is the cause of blushing, which is often produced by insignificant exciting causes, such as taking a glass of wine, coming from the cold into a hot room, and more especially by emotional influences, the presence of persons of the opposite sex, etc. Sometimes there is such throbbing in the larger arteries that a suspicion of aneurism is raised. The carotid, temporal and retinal arteries, and the abdominal aorta, are particularly liable to be thus affected. Such patients often complain of a burning heat in the head and neck, of throbbing in the arteries of those parts, tinnitus aurium, scintillating scotoma, vertigo, a feeling as if they were going mad or must jump out of the window, etc. These symptoms occur especially in young persons who have been addicted to masturbation, and who habitually complain of indigestion, general loss of power, etc.

The action of the two halves of the vasomotor centre is usually symmetrical, but in some cases we find paresis of one half and spasm of the other. One side of the head and other parts of the body is then red and congested, while the other side is blanched.

(3.) The Respiratory Centre

is also liable to be affected by spasm or paresis in the neurosis under consideration. *Spasmodic asthma* is often independent of bronchitis, emphysema, and other diseases of the air-passages, and evidently owing to undue excitability of this special centre. When such a condition has once been established, slight exciting causes may suffice to bring on a fresh attack. These are chiefly such as act upon the terminal branches of the pneumogastric nerve, whence the irritation is reflected upwards to the floor of the fourth ventricle. It is in this way that indigestion, certain atmospheric conditions, odours emanating from plants or animals, the inhalation of dust, etc., produce their well-known effects; while mental emotions may sometimes bring on an attack, and at other times arrest it, with equal suddenness.

A variety of asthma has been described as *dyspeptic asthma*, as it generally comes on after taking indigestible food. This condition seems to be owing to paresis of the respiratory and inhibitory cardiac centres combined, as there is immense acceleration of breathing (polypnœa) as well as of pulsation. The attack sometimes ends with the twin pulse. This form of asthma is best treated by an emetic, after which the pulse may fall rapidly from 200 to 70 or 80, with simultaneous relief of all other symptoms.

In other instances the respiratory centre appears to be in such a low condition that, from sheer lack of force, an insufficient amount of oxygen is carried into the lungs. In order to assist the deficient automatic action of this centre, such patients are seen to use the accessory muscles of inspiration, and to take deep and sighing, or even stertorous inspirations, so as to increase the quantity of oxygen in the blood.

(4.) The Pupillary Centre

shows occasionally a condition of undue excitability by exaggerated sensitiveness of the pupil to light and accommodation (hippus). In this condition there is a series of alternate dilatations and contractions of the pupils from one instant to another, while the external light is steady, and accommodation remains the same. Considerable exaggeration of the tendon reflexes is often associated with hippus; but Argyll-Robertson's pupil is never seen in this neurosis. On the other hand we may find signs of failure of power, as shown by unduly dilated pupils, and impaired sensitiveness to light. This condition may be unilateral, just as analogous affections of the vasomotor and sudorific centres; and inequality in the size of the pupils is therefore not always as ominous as it is believed to be by many observers. Moreover, Magnus has recently shown by systematic observations carried out in the eye-hospital of the University of Breslau, in 14,392 patients suffering from various diseases of the eyes, that inequality of the pupils is far more frequent than has been generally believed, as it was found in 143 cases, or 1 per cent., without any special local cause, such as inflammation, glaucoma, etc., or any more general cause, such as tabes, general paralysis, and other diseases of the nervous system. Of these 143 patients, 85 were males, and 58 females; and it occurred at all ages. The differences in the size of the pupils varied from 0·5 to 3 mm., and the right pupil was more frequently smaller than the left (76 against 67 cases). Magnus is of opinion that the sphincter of one pupil may in some eyes be originally more developed than that of the other. Such want of symmetry is also sometimes found in other corresponding parts of the body, which are not always absolutely the same. Magnus, however, appears to have only taken into account cases of coarse disease of the nervous system, and it is possible that in his 143 cases of asymmetry, a closer enquiry might have shown that a certain proportion of those patients were suffering from failure of power in one-half of the pupillary centre, together with other symptoms of the neurosis.

(5.) The Sneezing and Cough Centres

in the bulb, which are intimately connected with the respiratory centre, may suffer from hyperæsthesia, and lead to spasmodic attacks of sneezing and coughing.

Sneezing fits generally occur in the morning soon after waking, and go on for from a quarter of an hour up to two or three hours, during which time there is hypersecretion from the mucous membrane of the nose. In a single lady, aged 36, in whom these fits had come on after a bad attack of influenza, they lasted generally from first awakening in the morning until midday, and sometimes went on all day long, causing great distress, and also loss of taste and smell. She recovered under the influence of nervine tonics.

(6.) The Sudorific or Sweat Centre

may also show symptoms of spasm or paralysis, the latter being the most frequent. Slight physical or mental efforts, emotional influences, and similar causes are apt to lead in the asthenic to extremely profuse perspiration, or *hyperidrosis*, so that the patients are suddenly soaked in clammy sweat, and obliged to change their underclothing. Such attacks may occur during sleep, in consequence of disturbing dreams, and are generally followed by feelings of intense lassitude. Hyperidrosis may affect the entire body, or only certain parts, those most frequently affected being the head, the hands, and the feet.

Anidrosis, where perspiration seems to be entirely arrested, is likewise not uncommon. The epidermis is then extremely dry, rough, and harsh ; and the trouble is increased by exposure to cold, and especially to chilly winds, when headache, tightness and pressure in the head, etc., may be experienced.

(7.) The Lachrymal Centre

is in many patients in a state of almost constant hyperæsthesia, so that tears flow freely on the slightest occasion. This occurs not only in women, where it is often called hysterical, but also in men, who are unable to read, or to listen to the most ordinary things without bursting into tears.

(8.) The Salivary Centre

is not uncommonly affected by spasm, while excessive salivation is rare. A banker, aged 30, married, had been in good health until six months ago, when he was staying in the Isle of Wight, and greatly knocked up by the intensely hot weather prevailing there. Ever since then he had complained of a peculiarly dry tongue, which compelled him to swallow on the empty mouth, and also to drink a good deal of water and other liquids. He said that, although he had the greatest difficulty in swallowing on the empty mouth, he was obliged to do it. He had also a sighing, and sometimes a stertorous inspiration, and complained of general malaise and restlessness, especially at night. He had often to get up in the night and walk about his bedroom for an hour or two. He could not read a book, and suffered from great mental depression. His father had been a very nervous man, and had died of "softening of the brain," and his mother and a sister were also highly nervous. There was no local trouble in the mouth or pharynx, and the patient made a good recovery from what was evidently a pure neurosis.

(9.) The Vomiting Centre,

which I prefer calling the *gastro-intestinal centre*, is very apt to suffer in such cases. I have already drawn attention to the erroneous views of some authors, who consider all symptoms of failure of brain power as owing to indigestion. This is "putting the cart before the horse"; for the indigestion which is observed in such cases is in reality not the cause of the neurosis, but simply the consequence of perverted nervous influence arriving at the digestive tract from the gastro-intestinal centre in the bulb.

Dyspepsia is exceedingly frequent in this neurosis, and occurs, as most of these affections, in two forms, viz., as irritative and atonic dyspepsia.

a. Irritative dyspepsia is owing to hyperæsthesia of the gastric centre, causing undue excitability of the terminal branches of the pneumogastric nerve, with exaggerated reflex action in the muscular coat of the organ. In this condition the food, as soon as it enters the stomach, causes spasmodic contraction, by which the pylorus is closed, and the gentle movements of the fundus, which should take place during digestion, are prevented. This causes a feeling of heaviness and pressure in the stomach, and hypersecretion of acid, with heartburn. Peptonisation of the food is retarded, and when the stomach at last begins to move, the motion is still more or less of a spasmodic character, causing acid eructations, with loud belching, nausea, and tenderness in the epigastrium. In bad cases there may be vomiting, colicky pains, and gastralgia, and gastric ulcer and dilatation of the stomach may eventually become developed. The bowel is apt to participate in this condition, some portions being contracted and others distended. This may lead to habitual constipation and typhlitis; and pressure on the diaphragm by the distended intestine may cause palpitations, an intermittent pulse, headache, irritability of temper, and other nervous symptoms. In this condition the tongue is red and furred.

b. Atonic dyspepsia is owing to paresis of the gastric centre, in consequence of which the physiological movements of the pylorus and fundus are absent or deficient. The secretion of the gastric juice is thereby diminished, and digestion becomes slow. There is, however, no eructation, pain, nausea, or vomiting, and the tongue is pale and flabby.

Irritative and atonic dyspepsia are the two most frequent conditions met with in this neurosis; but a variety of other symptoms are apt to occur in a certain proportion of cases. Thus mastication, insalivation, and swallowing are often troublesome. Many patients suffer from a persistently dry tongue and mouth, so that eating without simultaneous drinking is almost impossible. The nasty, bitter, or otherwise unpleasant taste, which is frequently felt all day long, makes each meal a harassing duty. All food tastes alike. In some cases there is, superadded to this, atony in the masticatory muscles and the tongue, so that mastication is most fatiguing; or there is so much pain in the jaws that taking solid food becomes a torture, and only liquid nourishment can be swallowed.

In several marked cases of the neurosis I have seen *regurgitation* of half-digested food, which was by the patients called *rumination.* It is, however, only idiots and lunatics who really re-masticate their food habitually when it regurgitates. In the neurotic sometimes imperfectly digested food is brought up again an hour or two after eating, without any effort or feeling of sickness or disgust, in consequence of imperfect closure of the cardia during inspiration, when an aspiration of part of the contents of the stomach takes place. Such patients, however, never re-masticate pieces of food brought up in this manner.

Bulimia, or *polyphagia*, or extreme craving for food, is an unpleasant complication. Some of these patients are truly voracious eaters, and this is because they do not experience any feeling of satisfaction after eating. They therefore continue to gorge themselves, and feel driven to take additional meals between the ordinary ones. They are on the horns of a dilemma; for if they do not eat, they feel frantically hungry, and become exhausted and very cross; while if they eat too much, they suffer from dyspepsia and its attendant miseries. Towards the end of the digestive process many are troubled by a painful, empty feeling in the stomach, for which Boas has coined the word *gastralgokenosis*. This appears paroxysmally at night, and rouses the patients from their sleep, but vanishes almost directly after food has been taken.

The opposite condition, viz., loss of appetite, is more frequent than bulimia. What is called "*nervous anorexia*" (Gull) is, however, an extreme condition, and seen more frequently in hysterical persons than in those whose cases we are now considering. In them there is simply such utter loss of appetite that even the idea of a meal is looked upon with aversion, and the quantity of food is restricted to the smallest possible allowance. At the same time the patients have sense enough to know that they must eat something, but consider it a terrible bore to do so.

Nervous vomiting is, on the whole, rare. It is characterised by the extraordinary facility with which the contents of the stomach are brought up, the determining influence of emotions in its production, and the circumstance that the quality or quantity of food which may have been taken has nothing to do with it.

Another form of vomiting is that which has been described by Rossbach as *gastroxynsis*. This is more like a gastric crisis, such as we see in certain cases of tabes. After some noxious influence has acted on the patient, there is a sudden attack of burning, stabbing, and spasmodic pain in the epigastrium, with pressure on the head, general lassitude, sickness, and deeply-seated headache. The pain soon reaches an almost intolerable degree, when vomiting of a thin and very acrid liquid sets in, after which relief is gradually obtained. The quantity of hydrochloric acid in such cases amounts occasionally to four per cent. If such attacks succeed each other rapidly, the general nutrition and strength of the patient are greatly undermined.

Spasmodic belching is another unpleasant and often extremely obstinate symptom, which, if it is not readily removed, may lead to an alarming collapse.

The secretion of gastric juice and the quantity of hydrochloric acid present in the stomach do not seem to be of any particular influence in the causation of the phenomena just described. It is well known that in healthy persons the amount of hydrochloric acid present may vary from 1·5 to 2·5 per cent., and in the asthenic, secretion of acid may be diminished, normal, or increased.

In a certain number of these cases there is tenderness on pressure in the gastric and abdominal area, more especially the region corresponding to the position of the solar plexus, and the spinous processes of the third, fourth, and fifth dorsal vertebræ. Where these symptoms are marked, the neurotic character of the affection appears to be certain, and they may, therefore, be utilised for diagnosis.

The bowel is likewise apt to be disturbed in this condition. There are distressing sensations of pain, aching, and pressure all over the intestinal canal, or localised in certain places; and attacks resembling hepatic or renal colic may occur in the absence of gallstones or renal calculi (visceral neuralgia). Constipation is extremely common, and the habitual use of purgatives can sometimes not be dispensed with. The bowel is also liable to enormous distension (nervous meteorism). Constipation may alternate with diarrhœa. The re-absorption of effete and septic matter, which accompanies obstinate and longstanding cases of constipation, may lead to feverish attacks, which occasionally assume a typhoid character.

The following is an interesting case of obstinate constipation, in which laparatomy was performed, but the bowel found to be quite normal:—A young lady, aged 20, single, had an unimportant family history, but had a great tendency to catch infectious diseases. She had had measles four times; besides whooping-cough, pneumonia, mumps, and influenza on various occasions. Three years ago she fell from the top of a staircase, thirty-five steps down, and felt very dazed afterwards, but did not have any actual concussion of the brain. She had, however, much headache and backache afterwards, and began presently, without any other apparent cause, to suffer from extremely obstinate constipation of the bowels, so as to go for weeks without relief. When I first saw her, she had lost her appetite, was sick two or three times a day, had piles, suffered from unduly frequent menstruation, complained of severe pain in the region of the sigmoid flexure, and had a small and feeble pulse of 128, and had lost weight to a considerable extent. There was extreme tenderness on the cranium and the spine, as very slight percussion of those parts "nearly drove her wild." There was also insomnia, and a variety of other symptoms of encephalasthenia. I treated her for a short time with electricity, but without success; and as she had then gone four weeks without a motion, and the sickness continued, I feared that obstruction of the bowel was coming on, and requested a consultation with Mr. Herbert Allingham. We agreed that laparatomy should be done, and Mr. Allingham performed this operation in January, 1895. The whole bowel was then thoroughly explored, but without finding any stricture or other sign of disease. She recovered well from the operation, but the constipation continued afterwards just the same.

(10.) The Renal Centre

is almost invariably affected in this neurosis, the most common urinary troubles being polyuria and phosphaturia, with neutral or alkaline urine.

a. Polyuria, oliguria, anuria.—Polyuria is frequent in asthenics. Many patients pass from time to time an enormous quantity of urine, amounting in some cases to between 200 and 300 ounces in the twenty-four hours, and often without having taken an unduly large quantity of fluid. It has been stated that as much as 1,500 ounces have been passed in a single day, but this is probably apocryphal. This urine is called nervous, spastic, or hysterical. As section of the splanchnic nerves, which communicate through the pneumogastric with the bulb, is known to cause polyuria, while irritation of them leads to diminished urinary secretion, polyuria would correspond to failure of power in the renal centre; while anuria or oliguria, that is, completely or partially suppressed urinary secretion, would seem to arise from irritation of that centre. The latter condition is, however, generally owing to actual renal disease, or shock. In most cases of polyuria the density of the urine falls considerably; but when it remains normal, we speak of it as *diabetes insipidus*, which is generally accompanied by increased thirst, or *polydipsia*. In some cases, however, polydipsia is the primary condition, and polyuria simply the result of it.

We also meet with qualitative changes in the urine, the most frequent of them being

b. Phosphaturia.—The phosphatic urine may be clear when passed, or whitish and milky. In the latter case there is generally pain on passing it in the posterior portion of the urethra and the neck of the bladder, with shiverings, or feelings of heat, cold hands and feet, and a quick pulse, showing that the inhibitory, cardiac and vasomotor centres suffer together with the renal centre. The urine may be acid, neutral, or alkaline. Phosphaturia is often combined with a low density; I have found it as low as 1004. Boiling throws down an excess of phosphates in a clear urine, and thickens the deposit in the milky urine, probably by expelling carbonic acid, excess of which keeps the phosphates in solution. The addition of a few drops of acetic acid dissolves the sediment. Examination with the microscope shows amorphous deposits, and crystals of triple phosphates. Where these latter are very abundant, there may be attacks of *hæmaturia*, which has in such cases a mechanical origin and is intermittent, as the blood vessels of the pelvis of the kidney are able to resist the action of these crystals unless they happen to be very numerous. Phosphaturia sometimes alternates with oxaluria, which will be presently considered.

The excess of phosphates probably arises from undue combustion of the combined phosphorus of the brain in the form of protagon and lecithin. In some persons it only occurs after severe intellectual efforts, and is then almost invariably accompanied with mental depression, giddiness, and other symptoms of disturbed cerebral balance. It is of importance as a diagnostic test, being one of the few objective symptoms present in this neurosis, especially where there is a doubt about the reality of the patient's sufferings, which are often thought to be exaggerated or altogether invented. We also sometimes meet with the phenomenon known as "inversion of the phosphates," that is, an increase of the earthy over the alkaline phosphates, which is, however, more frequent in hysteria than in failure of brain power.

c. Glycosuria is more rarely seen in this neurosis than either polyuria or phosphaturia. The healthy urine contains a minute amount of sugar, varying from 0·1 to 0·5 in a thousand parts of water. Anything exceeding the latter constitutes glycosuria, showing that carbo-hydrates pass through the liver without decomposition, and reach the general circulation. Such glycosuria may be temporary or permanent, and does not constitute diabetes, the principal symptoms of which are absent. The quantity of sugar which is present in the urine is generally small, and varies from 0·1 to 1 per cent. The density of the fluid is, however, by no means always increased, and may even fall below the normal average. In most cases which I have seen it was found to vary between 1014 and 1020; in one case it was only 1008. As the sugar-test is sometimes omitted in the examination of the urine where the specific gravity is low, it follows that it is very important to test the urine for it in all cases where nervous symptoms are present.

In glycosuria the urine may also contain an excess of uric acid; and where such is the case, we may have symptoms of gout in addition to those of encephalasthenia. This is, however, by no means frequent. Glycosuria in the asthenic is not much influenced by any particular diet, and its origin has to be sought in paresis of Claude Bernard's centre in the bulb.

The glycosuria which occurs in this neurosis may generally be traced to intellectual or physical over-exertion, or to depressing emotional influences; and usually disappears by rest and the use of nervine tonics, more especially arsenic and antipyrin. That the integrity of Claude Bernard's centre is important for the general health, is seen from the fact that the patient is generally more incapacitated and depressed while there is sugar in the urine. There is often a kind of collapse, indifference to life, and feelings of despair. In some such cases the glycosuria is very temporary, and disappears quickly when the general condition of the patient improves, while in other instances it is more obstinate. I have seen cases in which there was phosphaturia, glycosuria, and albuminuria in the same patient, and where after a short treatment the urine had become perfectly normal. On the whole, however, glycosuria is a more serious symptom than phosphaturia. Patients affected with it are very vulnerable, and seem to have a tendency to catch such diseases as bronchitis and pneumonia, showing little rallying power when affected by them.

d. Albuminuria.—Temporary or permanent albuminuria is a tolerably common symptom in this condition. I have seen cases where it was associated with paresis of the cardiac and respiratory centres and sighing inspiration. Claude Bernard has shown that the epithelium of the glomerulus of the kidney requires an incessant and abundant supply of oxygen for its nutrition, and that as soon as there is a deficiency of that vital principle albumen will appear in the urine. Heidenhain considers that this epithelium has a special selective power on the blood, preventing the transmission of albumen, while allowing the passage of urinary water and salts. Anything which interferes with the nutrition of the epithelium may cause albuminuria. Albumen is therefore found not only in the various forms of nephritis, but also when there is loss of nerve power, with low arterial tension. The functional cases, in which there is no kidney disease, appear to constitute about one-third to one-half of all cases of albuminuria which come under observation. In spite of their being temporary and intermittent, they should be carefully watched, since serious deterioration is likely to follow unless dietetic and other measures are taken.

I lately had a merchant, aged 56, under my care, in whom this condition had certainly existed for thirteen years, and possibly much longer. After albumen had first been discovered in his urine, the patient had frequently caused the latter to be tested for it, and a small quantity of it had invariably been found to be present. The quantity of albumen generally varied between one-twentieth and one-twelfth. The heart and kidneys were quite healthy. The patient, however, suffered from a variety of nervous symptoms, more especially from different forms of fear, which from time to time overwhelmed him altogether.

In a New York Insurance Office one out of eleven apparently healthy persons who applied for insurance was found to have albumen in the urine, and at one time they did not put extra premiums on for young persons, but found that they were heavy losers. In England the proportion is smaller, being somewhere about two per cent. If this urine has a high specific gravity, the person thus affected may live on for many years, but if the density is persistently low, the life appears to be precarious. It is necessary to guard against chills by warm clothing, and to avoid excesses at table.

e. Oxaluria is rare in this neurosis, and generally owing to insufficient combustion of oxalic acid. When crystals of oxalate of lime are passed with the urine, painful spasm of the bladder is generally the result; but Prout's[147a] idea that this condition of the urine is the cause of all the nervous troubles which are found in such patients is quite unfounded. It often occurs in vegetarians, and after long-continued abuse of alkaline mineral waters, and is sometimes found to alternate with phosphaturia.

The complexion and general appearance of the patients differ a good deal. Some of them look so well that their friends refuse to believe in their sufferings, and withhold all sympathy from them. Others, however, have an anxious and careworn expression, and a sallow countenance.

The metabolism of the cellular protoplasma of the different organs of the body is frequently not much impaired, although the nutrition of the neurone may be suffering considerably. The proportion between the height and the body-weight of the patient may remain normal, even in cases where on account of digestive troubles the quantity of food taken is exceedingly small. I recently had a case under my care where eating, even of tiny morsels of easily digestible nourishment, caused so much distress immediately after ingestion that the patient had eaten next to nothing for about three months, when he came under my care; yet the body-weight had remained exactly the same as it had been twelve months ago. It is true that this patient did no work whatever, but spent his day lounging at his club, and strolling about the streets and the parks. His walking power was considerable, but the slightest intellectual effort made him feel so bad that he feared even having to sign a cheque; and any attention to business was quite impossible. He looked the picture of health, and his friends believed that he was a *malade imaginaire*, which he certainly was not. It was only the association-neurones of the hemispheres which were suffering in his case.

In other instances, however, variations in the condition of these neurones may be accompanied by considerable loss or gain in body-weight. Impaired metabolism may precede the development of the nervous symptoms, for instance, in post-influenzal troubles, or after exhausting discharges and hæmorrhages; or the bad condition of the neurone may lead to mal-assimilation, and loss of body-weight. In the latter class of cases this occurs in spite of increased ingestion of food which is sometimes taken in enormous quantities without apparently benefiting the nutrition of the association-neurones.

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Just as some authors are of opinion that all symptoms of encephalasthenia are owing to indigestion, others do not hesitate to aver that this neurosis originates frequently from *disturbances of the sexual function.* The latter opinion is as erroneous as the former, sexual troubles being, in the immense majority of cases, only symptoms of cerebral derangement. Masturbation, gonorrhœa, varicocele and analogous troubles occur in thousands of cases without leading to hypochondriasis or encephalasthenia; but where they appear in those neurotically predisposed, they may act either as exciting causes of a general loss of nerve force, or aggravate any symptoms of the latter which may have pre-existed. Krafft-Ebing[3] claims that there are three stages of this so-called "sexual neurasthenia," the first of which is the *local sexual neurosis*, in which there are only symptoms of irritation in the sexual sphere, such as unduly frequent nocturnal emissions of sperma, etc. The second stage represents a *neurosis of the lumbar spine*, with diurnal seminal emissions, premature ejaculation, certain urinary troubles, and symptoms of general spinal irritation. The third stage would be the *cerebro-spinal neurosis*, in which the entire nervous system is suffering. Similarly Löwenfeld[6] has proposed three different stages, of which unduly frequent emissions illustrate the first, spermatorrhœa the second, and impotency the third. I side entirely with Bouveret[4] and Binswanger,[7] who consider that the sexual symptoms of the asthenic grow, in the immense majority of cases, on a neurotic soil, and have no other significance than the digestive or cardiac troubles which are seen in the same class of cases.

Masturbation, or the *onanistic neurosis* (Fürbringer), leads chiefly to unduly frequent emissions and spermatorrhœa, while impotency occurs on such a base habitually only in the middle-aged. That such conditions are able to aggravate the condition of an asthenic patient, goes without saying; but onanistic troubles become of real importance only in those who are predisposed to nervous affections, or where the neurosis has already manifested itself by other symptoms.

Further sexual troubles which are apt to occur in the asthenic are pain in the penis, priapism, neuralgia of the testicle, irritable testicle, loss of erectile power, etc. I have treated of the various forms of impotency elsewhere,[143] and will therefore not return to this subject in the present place.

Sexual abnormities, such as satyriasis, nymphomania, exhibitionism, flagellantism, sapphism, *et hoc genus omne*, do not fall into the sphere of encephalasthenia, but of mental derangement.

Sexual troubles in women who are predisposed to, or suffering from, encephalasthenia are as common as they are in men. There may be hyperæsthesia and paræsthesia in the womb and its appendages, pruritus of the vulva and vagina, "ovarie," a throbbing or aching pain during walking, running, riding, etc. Such symptoms occur chiefly either before or during the catamenial period, and are associated with numerous other signs of disturbed nervous balance. In some cases they occur *intermenstrually*, *i.e.*, a fortnight before the period is due. While, therefore, a close connection appears to exist between ovulation and the occurrence of certain asthenic symptoms, it should not be forgotten that the latter may also be produced in the same persons by other causes, such as emotional excitement, trouble, anxiety, etc.

Krafft-Ebing[3] has drawn attention to the occurrence of a symptom in women which is analogous to seminal emissions in men, and which had previously been described by French authors as clitoridean crises, which appear occasionally in the course of locomotor ataxy. Discharges of the uterine and vaginal secreta may be caused by erotic dreams during sleep, or in consequence of sexual excitement during the day-time. If they continue to occur for some time, the symptoms of spinal and cerebro-spinal neurosis are apt to follow. There is a condition of "sexual erethism" or "clitoridism," in which there is constant excitement and unrest in the sexual sphere. An examination of the suffering parts reveals almost permanent erection of the clitoris, hyperæmia of the labia and vagina, with throbbing arteries, and fluor albus. Masturbation and unsatisfactory or interrupted coition are almost always the exciting causes of this distressing condition, which never occurs in normally constituted women.

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The course of encephalasthenia is apt to vary considerably. The onset may be acute, so that the patient is able to fix the day and hour when he began to be ill; but in the large majority of cases the symptoms come on gradually. The malady may last for months, years, or even a lifetime. Recovery is frequent, but relapses are common, more especially where the events of life are not favourable for permanent recovery, or where the neurotic inheritance is very marked.

CHAPTER IV.

THE NATURE OF THE NEUROSIS.

THERE does not appear to exist any organic or structural base for this malady which might be revealed by pathological anatomy, at least not with our present means of investigation. As most patients recover, the opportunities for post-mortem examinations are rare; yet even when death has occurred from attacks of tachycardia and other conditions, no structural changes in the brain have been discovered. Moreover, the sudden improvement and rapid recovery which takes place in numerous cases under appropriate treatment, or in consequence of a change in the circumstances of life, precludes the idea of the existence of coarse anatomical changes in encephalasthenia. We are therefore bound to look for the essence of the malady in an impairment of the finer nutrition of the neurones of the brain, brought on by bad inheritance and those other causes which have been discussed in the second chapter.

The precise kind of these nutritional changes has not yet been ascertained; but there can be little doubt that they must be intimately connected with the supply of blood and intracellular oxygen to the brain-cells. Catabolism may be, under given circumstances, more rapid than the fresh building up of the impaired structure. There may be changes in the *quality* of the blood supplied to the brain, as when there is anæmia, auto-intoxication, poisoning by chemical substances, or syphilis. Again, the distribution of the blood supply may be faulty, the *quantity* of blood supplied to the brain being lessened by spasm, or unduly increased by paresis of the vasomotor centre.

Making due allowance for all these circumstances, there remains a considerable number of cases to which such explanations do not apply; and it appears to me highly probable that another cause is active in the production of at least several forms of the malady. It is well known that currents of animal electricity exist in every living brain-cell just as well as in every living muscular fibre; and I think it highly probable that morbid changes in these brain-currents will eventually be shown to be at the bottom of many of the almost countless symptoms of failure of brain power. Unfortunately we are in this respect as yet in a *terra incognita*, of which only the barest outline or fringe are known; but a wide field for fruitful research seems to open up in this direction for experimental pathologists in, it may be hoped, not too distant a future. Physical and physiological reasons for my opinions have been given in the first chapter (pp. 54-57).

Most observers who have seen much of the neurosis in question are agreed that it is an affection *per se*, which deserves a special place in nosology, and is different from hysteria, hypochondriasis, and other diseases of the nervous system. A different opinion is held by Arndt,[149] who considers that the malady is only a stage leading to locomotor ataxy, myelitis, neuritis, encephalitis, and general paralysis, as well as to hysteria, hypochondriasis, epilepsy, bulbar paralysis, multiple sclerosis, etc., the character of which, according to him, does not develop till after a prodromial stage of many years, while the symptoms are at first considered to be merely owing to functional disorders, and under the circumstances naturally so! According to this author, therefore, the affection in question, although not a disease properly speaking, would be the commencement and starting-point of all the most serious nervous affections which are not the result of an accident, in fact, the soil on which they grow.

Perhaps no greater pathological paradox has been advanced in our time, and with such magnificent contempt for facts and the opinions of others, than Arndt's theory just referred to; and it is difficult to account for it except by assuming a limited clinical experience in nervous diseases on the part of its author. His theory is indeed contradicted by the records of thousands of cases which I might bring forward, and which would at once show it to be utterly erroneous and unsound. In the first place, I have known the simply asthenic condition to continue more or less unaltered for twenty and even thirty years without leading to any organic disease of the nervous system, the patients having eventually died from some inter-current malady, such as capillary bronchitis, pneumonia, contracted granular kidney, typhoid fever, and other diseases which had not the slightest connection with the neurotic condition. A far more important fact, however, is that the onset of organic disease of the nervous system is generally at once heralded by the appearance of definite special symptoms, for which no analogy is to be found in even protracted and severe cases of encephalasthenia, and which occur suddenly after the patient has enjoyed apparently good health. I have already mentioned a case of general paralysis, which began with an attack of temporary aphasia. In other instances the same malady has to my knowledge commenced, in apparently healthy persons, with epileptiform attacks, insane delusions, childish behaviour, incontinence of urine, and other symptoms for which there is no analogy whatever in the neurosis under notice. Again, locomotor ataxy often begins, in an apparently healthy man, with sudden paralysis of an ocular muscle, causing double vision, or with Argyll-Robertson's pupil, and loss of knee-jerk—all symptoms never seen in failure of brain-power. Hysteria may in its turn commence quite suddenly, without any premonitory symptoms, with a severe convulsive seizure, or a perfectly developed attack of hemi-anæsthesia, or loss of voice from paralysis of the adductors of the vocal cords, or a contracture of the flexor muscles of the arm. Similarly epilepsy may begin with a sudden attack of loss of consciousness and general convulsions, and tumour of the brain with loss of sight from optic neuritis, or an attack of Jacksonian epilepsy, or cerebral vomiting, etc. Of course I am well aware that symptoms of generally impaired nervous health sometimes usher in the commencement of coarse disease of the brain and spinal cord; indeed, I have myself drawn attention to this circumstance, and described such cases[150]; but I object *toto cœlo* to Arndt's dogmatic assertion that this is the rule. Even where there is the strongest neurotic inheritance, many persons continue for years in excellent health without ever complaining of a single trouble, when all of a sudden a slight symptom supervenes, showing that some portion of the nervous structure is degenerated or destroyed, and that an organic disease is on the point of being developed.

Arndt's singular misconception of the nature of encephalasthenia is further shown by his totally unfounded statement that "its peculiarities consist more in negative than in positive qualities, and that it is distinguished from other more marked nervous disorders, less by the qualities it possesses than by those which it does not possess!" Those who have perused the preceding chapter will be bound to acknowledge that the neurosis, as it is clinically observed, possesses an enormous number of positive qualities, and that Arndt must indeed be difficult to please if he is not satisfied with them as they stand.

While Arndt appears to stand alone with his erroneous conception of the nature of our neurosis, which he considers more serious than it really is, the opposite extreme is taken by many practitioners, who think that the complaints of such patients are all nonsense, and that, if they would only endeavour to pull themselves together and forget all about it, they would soon be "all right." Strange to say, this absurd notion was held by so distinguished a physician as the late Sir Andrew Clark,[151] who gave nothing but the cold comfort of mental self-discipline and self-effacement to such patients, stating that they were "*perhaps* suffering, but not in the ordinary sense ill!" We have seen what mental torture for a protracted period Professor Fechner underwent in acting according to this view, and that, although a man of the highest principles, he was by his sufferings brought to the verge of suicide. Yet he was only "*perhaps* suffering, but not in the ordinary sense ill!" Some applications of electricity *secundum artem* would probably have saved that distinguished man years of anguish.

Quite recently Goodhart[133] has treated this subject with a kind of amused smile and good-natured banter, as almost beneath serious notice. He appears to consider patients of this class as a tribe of harmless lunatics, who have got hold of the odd notion that they are ill, and who, if they would only be convinced that there is nothing the matter with them, would at once recover. Ten minutes' rational conversation would often appear to be sufficient to cure such persons of their imaginary troubles. It seems indeed a pity that they are often too stubborn to be convinced and cured by such reasoning, and should continue to suffer after they have been duly informed that it is all a mistake on their part! Goodhart seems to be so persuaded of the unassailable truth of his view that probably nothing short of an attack in his own person of the disorder which he professes to ridicule would shake his belief, and I will, therefore, not argue with him on this point. Persons who have undergone great sufferings for perhaps months or years past (*vide* Akinesia algera, p. 173); who have been disabled from following their occupation, and obliged to spend more money than they could well afford on change of scene and medical advice; who have perhaps taken a voyage to Australia in search of health, although they may hate the water and consider a ship a prison; who have swallowed gallons of nauseous medicines, and have been douched, massaged, stuffed, and even fired without finding relief—such persons may well be staggered when they are eventually told by authorities that the whole thing has been nothing but a mistake on their part, and that they have never been ill at all!

Playfair[152] shows a far deeper insight into the nature of the affection when he says that "*It constitutes a very real and very important malady*, the existence of which, however, has only been recognised of late years,* and which we have not seen sufficiently recognised in any of our medical text-books."

I consider it the duty of the physician, when such cases come before him, to accept statements made by patients in apparent good faith and in a straightforward manner, especially where there appears to be no intention to exaggerate or to deceive, nor any motive which would induce them to utter deliberate falsehoods. He will do so all the more readily when he finds that the symptoms complained of tally, as a rule, absolutely with those which have been mentioned to him by hundreds of other patients of whom it would be utter folly to suppose that they should have joined in a conspiracy to deceive the doctor. He will also look out particularly for such objective symptoms as I have found to exist in the malady, if not invariably, at least very frequently, viz., the urinary triad of low density, neutral or alkaline reaction, and excess of phosphates, as well as exaggerated tendon reflexes without simultaneous muscular rigidity, and tender spots in the epigastrium, abdomen, and the dorsal spine. I think it wrong and cruel to tell a person who is suffering anguish—or, as one of my patients, a quiet, sensible man, lately expressed it, "Hell

* With this part of Playfair's statement I am bound to disagree, as I have shown that the malady has always existed, and has been described by many authors under different names (p. 5).

on earth"—that there is nothing the matter with him; and confidence will be gained by accepting the view that the patient is really ill, which is indisputably the fact. Fortunately the prognosis is favourable in the immense majority of cases of encephalasthenia; and the physician may, therefore, with that confidence which is gained by experience, inspire the patient with the hope that he has good prospects of recovery.

A few considerations will suffice to refute the view held by some authors that in some cases of this neurosis, the brain, in others the spinal cord, and again in others the sympathetic system of nerves is suffering. There is not a single symptom which cannot be satisfactorily accounted for by a morbid condition of some area in the brain. As for certain apparently spinal symptoms, it should be remembered that Risien Russell[121] has found one of the functions of the cerebellum to be to energise the spinal cord. Russell's theory on this important point is confirmed by a very interesting case of cerebellar disease which has recently been recorded by A. W. Campbell.[153] In that case thrombosis of the left inferior cerebellar artery had caused softening of the cerebellum, which, in its turn, had led to destruction of the direct cerebellar tract on the same side, as well as to disease of the crossed pyramidal strand, the nerve-cells in Clarke's column, the antero-lateral tract, and the posterior root-zones; showing that the nutrition of all these parts is under the direct influence of the cerebellum.

On the other hand, the sympathetic system of nerves is generally acknowledged to be dependent upon the cerebrum. It is notorious that in every case of so-called "spinal or sexual neurasthenia" symptoms occur which can only be explained by an unsatisfactory working of the general cerebral mechanism, and an additional proof is thus furnished showing that this is the sole and constant source of all the morbid phenomena which may be observed in the neurosis under consideration.

CHAPTER V.

THE DIAGNOSIS OF ENCEPHALASTHENIA.

It has been remarked by several authors that there are no objective symptoms met with in this disorder to help us towards a diagnosis. I would qualify this statement by saying that there are *few* such symptoms, and that these are not invariably present. I have already spoken of the triad of objective signs which has often aided me in the diagnosis of otherwise doubtful cases, viz., a peculiar alteration in the urine, which shows low specific gravity, neutral or alkaline reaction, and excess of phosphates. The density may sink to 1002, especially where there is polyuria at the same time. 1004 is rather common even without polyuria, and a low density is usually observed unless there is complication with some form of arthritis, when the density may be 1030 and upwards. This higher density is chiefly owing to an excess of urea. The excess of phosphates is sometimes very considerable. There are, however, cases where the urine is normal, and where its examination does not give us any hints of value.

Another objective symptom which is common is an increase of the tendon reflexes, especially the knee-jerk, without rigidity of the muscles. In the ordinary form of hemiplegia, in spastic spinal paralysis, and in other forms of cerebral and spinal disease, there is always a degree of contracture of the muscles combined with the increase of tendon reflexes. The combination of these two symptoms also holds good for most cases of hysteria, in which exaggeration of the deep reflexes is observed; and the simple increase of these reflexes without simultaneous rigidity is therefore of diagnostic value. On the other hand cases are met with in which they are either normal or sluggish, so that the value of this symptom is not absolute.

Where dyspeptic troubles are present, and are associated with tender points in the gastric and abdominal area, more especially in the region of the solar plexus, and spinous processes of the third, fourth, and fifth dorsal vertebræ, the diagnosis of encephalasthenia may be looked upon as certain.

On the other hand, the absence of certain objective symptoms is often of considerable significance. Where we have to do with aphasia, muscular paresis, rigidity or atrophy; with anæsthesia, analgesia, hemi-anæsthesia, delayed sensation, loss of the senses of temperature, locality, and pressure; with loss of the knee-jerk and other deep reflexes; with Argyll-Robertson's pupil, or optic neuritis or atrophy; with a decided limitation of the field of vision; with anosmia or hemi-anosmia, and with some forms of gustatory paræsthesia:—in all such cases we may be certain that we are in the presence of other diseases than encephalasthenia.

Amongst the subjective symptoms those most important in a diagnostic point of view are the feelings of fear, panic, terror, and alarm; indeed, all the different varieties of *phobia*, which have been previously described. These symptoms are very common in the neurosis under notice, and do not occur in the same way in hysteria, or organic diseases of the nervous system.

Next in importance rank the peculiar sensations of pressure, tightness, weight, rigidity, creeping, crawling, and other forms of paræsthesia in the head, which are so common in the asthenic. In hysteria and coarse brain-lesions there is more actual headache and pain than such forms of paræsthesia, which form, indeed, a characteristic feature of the neurosis under consideration.

The principal diseases with which encephalasthenia may be confounded are hysteria, hypochondriasis, softening and tumour of the brain, and general paralysis of the insane in their initial stages. The diagnosis of these different conditions is sometimes a matter of extreme difficulty, and can only be arrived at by a careful examination of all the different organs of the body. Every one of these should be thoroughly overhauled, symptoms which may be absent being quite as important as those which may be present.

1.—Softening of the Brain.

This may be induced suddenly through embolism of a cerebral artery, or more gradually through thrombosis. The embolic form of softening, in which there is a sudden attack of apoplexy with hemiplegia, cannot be confounded with asthenia. In that form of softening, on the other hand, which is owing to thrombosis, and in which the cerebral bloodvessels become gradually constricted and eventually plugged, symptoms showing a diminished supply of blood to certain portions of the brain may exist for months before an attack of aphasia or hemiplegia or monoplegia will take place.

While encephalasthenia is a disease of the prime of life, softening from thrombosis occurs chiefly in the aged or prematurely aged. It is frequently owing to failure of the heart's power, and to that degeneration of the bloodvessels which is peculiar to senility; but it is also sometimes seen in the young, when the heart has become weak and dilated in the course of acute exhausting diseases, such as smallpox, typhoid and scarlet fever, and pneumonia; again, it is met with after syphilis, and great fatigues and privation. Age alone is therefore not a distinctive diagnostic feature.

The symptoms of softening of the brain are owing partly to degeneration of the coats of the large cerebral arteries, causing defective circulation of blood in the corresponding areas of the brain, and partly to the fact that even at an early stage of the affection some of the smallest bloodvessels may become plugged, whereby softening of tiny portions of brain-tissue is caused. Such symptoms, however slight, are therefore always owing to definite organic changes in the brain.

We find in cases of this kind two types of the disease, which appear to be owing to different localisation, and which may be described as "Rolandic" and as "Medullary."

a. Rolandic Softening.—In this form of softening of the brain, which is generally owing either to senility or syphilis, we find as a rule both general and local symptoms. The general symptoms may resemble those which we have seen to occur in encephalasthenia, viz., a bewildered, confused feeling in the head, giddiness, impaired memory, mental irritability or depression, and difficulty in fixing the attention. To these signs, however, there are almost invariably added, sooner or later, localised symptoms, which are never seen in the neurosis under notice. Thus there may be decided loss of power and paræsthesia in one half of the body, or in one arm, or one leg, which will afterwards become paralysed. There is great awkwardness in using the fingers, in writing, dressing, drawing, etc., or in walking, and this awkwardness cannot be overcome by a volitional effort. We have seen that such symptoms are occasionally present in encephalasthenia, but that they are owing to distraction of the mind, and can be rectified by drawing the patient's attention to them. There is also often defective articulation in Rolandic softening, which never occurs in the asthenic at all, and somnolence or drowsiness, which is more pronounced than it ever is in our neurosis.

All these symptoms may be somewhat fitful in their appearance, so that the patient is sometimes better and sometimes worse, until an attack of apoplexy, or aphasia, or monoplegia, or hemiplegia takes place, which at once impresses a peculiar stamp of its own on each individual case.

b. Medullary Softening.—This form of softening occurs in the tissue of the centrum ovale, the corona radiata, and the internal capsule, and is likewise due to thrombosis of the bloodvessels of these tracts. Medullary softening is distinguished by an absence of general symptoms, as the cortex does not suffer; and the symptoms are therefore purely focal or localised. We see in such cases slowly progressive hyperæsthesia, paræsthesia, hemi-paresis, hemiplegia, and hemi-anæsthesia with atrophy and rigidity—all signs which indicate a condition absolutely different from encephalasthenia. There are no "ups and downs" as in Rolandic softening, nor do we meet with sudden attacks of apoplexy, aphasia, hemiplegia, or monoplegia.

2.—Tumour of the Brain.

The cardinal symptoms of tumour of the brain are headache, optic neuritis, giddiness, nausea, and vomiting; and, if they are all present, the diagnosis presents no difficulties. It may, however, happen that all these signs are absent not only in the beginning, but also in the further course of the disease. Pel[154] has lately described an interesting case of this kind, in which, although none of the signs just mentioned were present, yet the diagnosis was correctly made, chiefly by hemi-paresis, impaired memory, mental dulness, dysphasia, and attacks of Jacksonian epilepsy. The seat of the tumour was diagnosed to be in the arm-centre. Trephining was performed in that region, and the tumour found and enucleated. It was nearly as large as a hen's egg, and turned out to be a benign fibroma, traversed by large lymphatic spaces. Unfortunately, the patient died soon after the operation.

The chief difficulties inherent to the diagnosis of brain-tumour are owing to the fact that the disease may remain latent for a considerable period, so that there are hardly any symptoms even when the tumour has already attained a considerable size; while again a tumour may, by pressure on the surrounding brain-tissue, cause such numerous remote signs as to render localisation impossible. This latter happens chiefly when the growth is situated close to the skull-bones, or to the tentorium, or the falx cerebri, which parts, from their rigid structure, do not yield as readily to the pressure of the tumour as the softer structure of the brain itself. Increased intracranial pressure is, however, the invariable consequence of every brain-tumour, and general symptoms due to this precede habitually the focal signs of the growth.

The first sign of a brain-tumour may be a feeling of general malaise, want of energy, irritability of temper, and drowsiness. The patient is depressed in spirits, inclined to be lachrymose, indifferent to the events of daily life, and wishes to be left alone. The memory is impaired, and there is a difficulty in fixing the attention. The next principal symptom is *headache*, which may affect the entire head or only a portion of it. It is not generally localised in that part which corresponds to the seat of the tumour, for a growth in the cerebellum may cause frontal headache. It varies from a simple feeling of soreness, fulness, or heaviness, to the most agonising pain, which sometimes causes the patient to faint away and lose consciousness for a long time. It is often paroxysmal, and increased by pressure, percussion, and reflex movements, such as coughing and laughing, by movements of the head, by a glaring light, or a sudden noise. If on percussion of the skull local tenderness is found in a small area, the suspicion that the headache may be owing to tumour gains ground. When there is much cranial tenderness the tumour is seated close to the bone. A tympanitic percussion sound over such a spot is also significant, and is owing to wasting of the skull-bones caused by the pressure of the tumour. I have described an interesting case where this symptom was present, in the "Transactions of the Clinical Society" for 1896.[155] The headache of brain-tumour has the peculiarity of constantly getting worse, and remedies do little or nothing to relieve it. It is therefore shown to be quite different from the various distressing sensations in the head which we have seen to occur in the asthenic. In asthenia the commonest complaint is that of pressure and tightness, as if the head were in a vice, or a heavy weight on the top of it; or there are creeping, crawling, and wavy sensations and "light-headedness"—in short, sensations different from the headache of brain-tumour.

Another cardinal symptom of the latter is *optic neuritis*, which may, as Hughlings Jackson has pointed out, be at first unaccompanied with loss of sight. Vision is, indeed, frequently only impaired in the later stages, when atrophy of the optic nerve has set in. Optic neuritis is likewise owing to the increase of intracranial pressure caused by the tumour, and may, for that reason, be present in other diseases accompanied by undue pressure, such as abscess of the brain, and internal hydrocephalus. This symptom is, in a fully developed form, never seen in encephalasthenia. I have described on p. 137 a case in which there were traces of a slight attack of optic neuritis having occurred at some previous period; but in the first place this was not a case of the pure neurosis, but a borderland case; and, secondly, the inflammation had been very slight, and had become arrested long before the patient came under my care.

Vomiting is a further important symptom of brain-tumour, and produced by pressure of the growth on the gastric centre in the bulb. It usually occurs without retching or apparent effort, and may be the first of all symptoms. It is quite independent of the condition of the stomach, which may be normal, and it therefore cannot be confounded with the vomiting which takes place in the irritative form of neurotic dyspepsia, in which, as we have seen, many other gastric symptoms are present.

Vomiting is often accompanied with giddiness, more especially in cerebellar tumours, and bradycardia, from irritation of the inhibitory cardiac centre in the bulb.

In so-called "suspicious cases," that is, when there is an absence of headache, vomiting and optic neuritis, the chief symptoms have been classed by Hughlings Jackson as those of "over-action" and "want of action," corresponding to our "undue excitability" and "depression." The former may be attacks of Jacksonian epilepsy, or local muscular spasms, or local subjective sensations, such as tingling, pins and needles, etc.; while the latter consist of progressive sensori-motor paresis or paralysis of one side of the body, which may be combined with muscular atrophy and rigidity. These symptoms are not only apt to occur in tumour of the Rolandic convolutions, but also when the growth is situated elsewhere, providing sufficient pressure be caused by it on the Rolandic region. They cannot therefore be looked upon as strictly localising symptoms. Jacksonian fits occur at first on the side opposite to the growth, but in the further progress of the case they generally affect both sides of the body, and are then accompanied with loss of consciousness. Such seizures may become very frequent towards the end, when there may be likewise imbecility, or attacks of mania with delusions and hallucinations, incontinence of the urine and the fæces, extreme emaciation and general paralysis. Death is preceded by coma or apoplectic seizures. Symptoms of this kind never occur in encephalasthenia; and I do not think it necessary to enter into a description of the focal symptoms caused by brain-tumours according to their seat in different portions of the brain, as what I have said will suffice to show that a growth in the brain can hardly ever be confounded with our neurosis, except in its earliest stages.

3.—General Paralysis of the Insane.

This affection may, in its first stage, be attended by similar symptoms as the neurosis under notice, especially in cases where the mental symptoms predominate over the physical signs. A diagnostic error in such cases is particularly unpleasant for the medical man as well as for the relations of the patient. A favourable prognosis has often been given in a case of general paralysis, with loss of credit to the doctor; while on the other hand the patient's family have been unnecessarily alarmed by an adverse prognosis in a case of simple failure of brain power.

The invasion of general paralysis is often ushered in by an alteration in the behaviour and character of the patient, who becomes unduly emotional, loses his memory and power of work, suffers from insomnia, mental depression and giddiness, strange feelings in the head, and a general failure of mental power. With these symptoms which are merely suspicious, there are however, in general, other signs associated, which leave little doubt on the mind that we have to do with a serious organic lesion of the brain, and not with a merely functional disorder.

Such symptoms are chiefly a thorough mental alteration in the patient, who may become actually childish, or show a kind of gay recklessness, with tendency to squander money and invest in hazardous speculations. There may also be attacks of mania and hypochondriacal melancholia, of epilepsy and apoplexy, delusions of grandeur, and utter loss of volitional power. In one of my patients, who had been very clever in business, the first symptoms were that he had a difficulty in casting up figures, which formerly was mere child's play to him, and in taking percentages, which now always turned out to be wrong. He became disconnected in his conversation, unduly excitable, was less master of himself, and drowsy after exertion;

he was odd in his manners, quarrelsome at home, spoke to any one he might meet in the street about intimate family affairs, and laughed immoderately at every rejoinder. While formerly he had a good ear for music, he now sang in church most awfully out of time and tune, without being aware of it. Soon afterwards he took steps for procuring a judicial separation or divorce from his wife without any cause, and had such twitches in his right hand that he found it impossible to write, to carve, or to dress himself without assistance. Epileptic fits and mania supervened eventually, and he had to be placed under restraint.

Other distinctive features are that the patient threatened with general paralysis has not the feeling that he is ill, but often asserts that he was never better in all his life, while the asthenic feels his wretched condition very acutely. Again, the memory and intellect are more decidedly impaired in general paralysis than in asthenia, where they often only appear to be bad, because the patient is distracted by his sufferings. In general paralysis there are rarely compulsory thoughts, which are so frequent in asthenia, and insomnia is more obstinate in the former than the latter condition. In general paralysis the pupils are apt to be sluggish and unequal, and there may be optic neuritis and myosis. Such signs never occur in asthenia, where the pupils are generally large, but respond well to light, and where we find more the symptoms of hyperæsthesia and asthenopia.

Amongst the physical symptoms of general paralysis which distinguish it from asthenia I would also mention signs of *locomotor ataxy*, viz., loss of knee-jerk, Argyll-Robertson's pupil, optic atrophy, lightning pains, incontinence or retention of the urine, loss of sexual power, etc. Or there may be attacks of temporary aphasia, or the speech may be slow and halting, with impossibility of pronouncing long or difficult words, such as incorrigibility, Mediterranean, etc.

Some years ago I was consulted in the case of a gentleman, aged 32, married, who had no "damnosa hereditas" whatever, but had contracted syphilis five years ago. The first symptom of central disease, four years after the primary sore, was that he lost his speech for five minutes. During the attack he was able to write, and his wife being present, he took up pen and paper, wrote on it that he had lost his speech, and handed it to her. He then as suddenly regained his speech, and nothing further happened until three months afterwards, when he had a similar attack, which lasted, however, for twenty minutes, and was accompanied with severe giddiness. His wife being again present, she handed him writing materials, but he shook his head, took up a pencil, and scribbled a few unintelligible words. The third attack occurred after witnessing the boat-race, during which the patient showed signs of excitement which he had not had before. He then not only lost his speech for twenty-four hours, but also became unconscious, and had monoplegia of the right arm. After this there was a *facilis descensus Averni*, and the patient died, with fully developed general paralysis, two years after the first attack of aphasia. Such occurrences are never seen in cases of encephalasthenia under any circumstances.

The handwriting in general paralysis is more profoundly altered than it is in asthenia; it becomes shaky and indistinct, words are left out or repeated, and mistakes are made in spelling. A grammatical construction of sentences may even at this early stage of the disease become impossible. There are often twitches in the facial muscles, tremor of the tongue, and eventually Jacksonian fits.

It is not necessary for me to enter into a comparison of the symptoms of the second and third stages of general paralysis, as they have nothing in common with those of the neurosis under notice.

While, therefore, in the large majority of cases the early symptoms of general paralysis greatly differ from those of encephalasthenia, we occasionally meet with instances in which serious difficulties may present themselves. Such cases are now generally designated as Pseudo-General Paralysis, which, of course, is no diagnosis. Recovery may take place in them, and it is sometimes impossible to decide at the time whether such recovery is likely to remain permanent, or whether it must be looked upon simply as an instance of remission.

Some years ago I was consulted in the case of a married lady, aged 43, the mother of six children, who, when 29 years old, had had an attack of aphasia and right hemiplegia, from which she recovered in the course of twelve months. She had another similar attack at 35 years, and also gradually recovered from it. Twelve months ago she had a great shock to the system by seeing her little son drowned, "the brightest of the family." When I examined her, I found her very vacant; she stared at me without answering questions. I was informed that she often did not finish her sentences when talking, that she had quite lost her memory, and sometimes became very much excited, laughed a good deal without any cause, and behaved otherwise in a silly manner. She lived unhappily with her husband, of whom she was excessively jealous without any cause. She had great difficulty in walking and standing, and her gait showed that peculiar awkwardness which is seen in so many instances of the first stage of general paralysis. It required the greatest trouble to get her into a carriage. She was very clumsy with her fingers, could not dress herself, or thread a needle. The knee-jerk and other deep reflexes were considerably exaggerated, but there were no stigmata of hysteria. I looked upon the case as pseudo-general paralysis, and treated her with mercury and iodide of potassium, under the influence of which she improved considerably during the first month, and after two months' treatment was perfectly well. Six months afterwards I was informed that her health had continued good.

Another similar case was that of a widow, aged 43, and the mother of five children. She had been out of health ever since her husband's death five years ago. During the three months before I saw her, there had been a very striking change in her manner; she had shown difficulty in collecting her thoughts and in "pulling herself together"; spent much time over trifles, showed a mania for writing unnecessary letters and cleaning ornaments, stood for hours in her bedroom with open door and windows, doing nothing, refused to go downstairs, and could not settle for sleep. She appeared to be indifferent to her children, of whom she had formerly been extremely fond, and callous to her own appearance. All the deep reflexes were exaggerated in the upper as well as the lower extremities; she dragged her feet in walking, shuffling them along the ground, and was awkward in getting into a carriage and in going upstairs or uphill. She had suffered from incontinence of urine and matutinal vomiting. Her father and two uncles had died from paralysis. She was treated chiefly with hypodermic injections of cerebrine alpha, and completely recovered her mental as well as physical health in about three weeks' time.

Such cases are very peculiar, and require further investigation. They may, perhaps, eventually turn out to constitute an uncommon and severe variety ("forme fruste") of encephalasthenia, as coarse organic changes cannot have been present when there is such rapid recovery under treatment.

4.—Hysteria.

Perhaps there is no disease on which the views of the best observers of all times have varied so much, and still vary at the present moment, as hysteria. The complaint has been known from the commencement of civilisation, and received its name from the Greek physicians, who believed it to arise from the freaks and vagaries of a dissatisfied and ill-tempered uterus. I have elsewhere described the various theories which have been held on the malady,[156] and will, therefore, in this place only say that hysteria is at the present time looked upon rather as a *psychosis than a neurosis*, and that its characteristic feature is considered to be a disturbance in the lower levels of the mind, that is, in sentiments, moods, and impulses, as distinguished from perception, thinking, and volition. Such patients are excitable, cross, upset by the least annoyance, capricious, fanciful, and too ready with giving sympathy or showing antipathy. Depression alternates with undue excitability, and if the patient's sufferings are not sufficiently dwelt upon and made much of, outrageous actions may be performed in order to excite the astonishment of friends or strangers, while certain symptoms may be exaggerated in the grossest manner. As the case progresses further, the higher mental functions begin to suffer; there is indecision, loss of volition, imperative ideas, and eventually actual derangement. The mental symptoms of hysteria are therefore seen to be of a very different character from those of encephalasthenia, in which chiefly the higher levels of the mind are suffering, as shown by deficiency in sustained attention, consecutive thinking, and volition; while outrageous actions, such as lying, cheating, false accusations, shamming, malingering, etc., never occur in that neurosis.

An equal difference is shown between the two maladies as regards physical symptoms. In the *motor sphere* we find in encephalasthenia, on the whole, only insignificant signs, while in hysteria these are generally of the most varied and striking description. Thus there are in the latter disorder many forms of want of action, such as hemiplegia, paraplegia, astasia-abasia, aphasia, deaf-and-dumbness, ptosis, aphonia from paralysis of the adductor muscles of the vocal cords, polypnœa, paralysis of the œsophagus, anorexia nervosa, tympanites, etc., and numerous forms of over-action, such as general convulsions with the character of opisthotonus, hystero-epilepsy, chorea major, catalepsy, somnambulism, fits of laughing, crying, sneezing, gaping, coughing, dyspnœa, etc., as well as localised spasms affecting the throat (globus), the muscles of mastication, the muscles of the eye (strabismus and blepharospasmus), stammering and other disorders of speech, spasm of the diaphragm (singultus), of the stomach and intestines (belching, vomiting, regurgitation of food, diarrhœa, and constipation), of the bladder (spasmodic retention of the urine), etc.

Symptoms in the sensory sphere occur very frequently in both maladies which we are now considering. Certain forms of hyperæsthesia and paræsthesia are, indeed, common to both; yet even there the hysterical patient shows, on close examination, peculiarities which are not found in the encephalasthenic. There is, for instance, in the latter no ovarian pain or tenderness, no hysterogenous zones, less spinal irritation, no hemicrania or clavus, which in hysteria may be very severe. The principal difference, however, is that anæsthesia is frequent in hysteria, and absent in encephalasthenia. In hysteria not only anæsthesia but analgesia are common, and may affect limited areas, or one side of the body—hemi-anæsthesia—in which the skin, the mucous membranes, muscles, joints, and organs of special sense are affected, and where the phenomena of transfer of the affection from one side to the other may be elicited. Sometimes there is anæsthesia of the whole surface of the body. In the visual sphere we find amblyopia and amaurosis, owing to anæsthesia of the retina, without ophthalmoscopic signs, hemianopsia, limitation of the field of vision, dyschromatopsia, or achromatopsia; while in the sphere of the other special senses we meet with deafness, anosmia, and ageustia. None of these symptoms are ever seen in encephalasthenia.

Bulbar signs, which are so common in failure of brain power, are rare in hysteria. We meet, however, occasionally with pallor and blushing, increased or diminished salivary secretion, polyuria, ischuria, and anuria. One bulbar symptom which is common in hysteria is never seen in encephalasthenia, viz., hæmorrhage, which is owing to intense irritation of the vaso-constrictor centre in the bulb. Hysterical hæmorrhage may proceed from the gums, the nose, the lungs, stomach, and bladder, and frequently offers considerable diagnostic difficulties.

Seeing all these enormous differences in the symptoms of hysteria and encephalasthenia, it seems incomprehensible that such a distinguished clinical teacher as Leube[157] should consider the latter a simple variety of the former. Encephalasthenia may occasionally be complicated with hysteria, but I look upon it as an actual wrong done to a woman suffering from the former neurosis to pronounce her to be hysterical.

5.—Hypochondriasis.

This condition is, like hysteria, in its fully developed form rather a psychosis than a neurosis. The patient experiences a feeling of profound illness, with tendency to exaggerate the excessively painful sensations which trouble him, and to brood over their origin, degree, and eventual issue. As long as no further development of the illness takes place, he is therefore in the same condition in which many asthenic persons are who suffer from the emotional fears which have been called nosophobia or pathophobia, etc., and who expect to become paralysed or insane. In both there may be at the same time mental depression, incapacity for work, and undue introspection into the working of the system. But in the hypochondriac there will be presently a further development, which removes the condition from the lines on which encephalasthenia is habitually running, and imparts to it a peculiar aspect of its own. Such a development is compatible with otherwise fair mental powers and with longevity, while in other cases it turns into melancholia, with tendency to suicide and other serious affections of the brain.

As the painful sensations which the patient has experienced for some time increase in intensity, they become a more absorbing occupation for his mind, and lead him to form an often utterly absurd and preposterous opinion about some peculiar disease of which he imagines himself to be the victim, and which he frequently invents in order to suit the sensations of the moment. These sensations occupy chiefly one of three spheres, viz., the brain, the digestive tract, and the sexual organs.

In the *cerebral form* of hypochondriasis the patient has uneasy and strange sensations in the head, which induce him to think that his brain has become softened or destroyed, or is being eaten away, or that something has burst in his head, and that insanity is approaching. From the extreme persistence of these sensations, and from the fact that they are frequently rebellious to treatment, and that dementia is sometimes developed in such cases, I have been led to conclude that there must be a definite anatomical base for this condition, which I believe to be a very slow and insidious form of sclerosis, invading the highest neurones, which become gradually wasted, and replaced by proliferated connective tissue.

In the *digestive form* of hypochondriasis the patient keeps looking at his tongue and feeling his pulse, examines his urine and fæces, and carefully studies his complexion in the glass with the view of discovering a yellow tinge. He may have a feeling that the throat is diseased, and that he is unable to swallow. For this reason food may be refused, and hydrophobia is expected to occur. In other cases there are distressing sensations in the epigastrium, where cancer or rupture or holes or ulcers are suspected to exist, or the patient believes himself to suffer from obstruction of the bowels, which prevents the passage of food, or from closure of the anus, or loss of control over the rectum, etc. This variety of hypochondriasis may be owing to a similarly insidious sclerosis of the solar plexus of nerves, more especially where the patient flies to alcohol for the relief of his troubles, while in other instances it may be the result of auto-intoxication.

The *sexual variety* of hypochondriasis is that in which the patient believes himself to be affected with impotency, and sometimes commits suicide on the eve of marriage, or is subject to exaggerated ideas about the deleterious influence of masturbation and nocturnal emissions of sperma. In some such cases I have eventually known locomotor ataxy to become developed, and have been led to the opinion that the sexual hypochondriasis is connected with the first beginning of an insidious form of sclerosis of the posterior columns of the lumbar enlargement of the spinal cord.

6.—The Uric Acid Diathesis.

The relations between arthritis and the neurosis under notice have already been mentioned. Haig,[158] who has done so much good work on the uric acid diathesis, considers that excess of uric acid may, by causing undue contraction of the cerebral arterioles and capillaries, lead to headache, epilepsy and depression, and that such conditions may be cured by reducing the amount of urea to 400 grains daily, chiefly by means of altered diet, as, for instance, by substituting small quantities of milk and fish for meat. The pulse and the urine therefore constitute the chief diagnostic tests. I have, however, already mentioned that in encephalasthenia high tension of the pulse and high density of the urine are exceptional, and low tension and density the rule, so that in the headaches and depression of that neurosis, excess of uric acid rarely enters as a causative factor.

Apostoli[159] has recently stated that the neurosis which we are now considering habitually grows either on an arthritic or hysterical soil, and a similar opinion had already been previously expressed by Huchard[160] and other French authors.

This would make one feel inclined to think that the disease is different in France from what it is in England, yet I find such an able observer as Bouveret[4] expressing the diametrically opposite opinion on this point. According to him the nerve pain which occurs in failure of brain power is often erroneously put down to gout, and the patients are believed to be suffering from arthritis when they are really neurotic. My personal experience leads me to side altogether with Bouveret as far as this point is concered.

Charcot, whose splendid discernment and discrimination have done so much towards elucidating numerous obscure points in the pathology of the nervous system, does not appear to me to have been as happy as usual, but somewhat too dogmatic in his conception of encephalasthenia. He has distinguished two different series of symptoms, of which he calls the first the cardinal, fundamental, and typical signs, or "neurasthenic stigmata," while he qualifies the second series as accessory symptoms, which are unnecessary for making a diagnosis and have nothing specific about them, but become developed according to individual predisposition or etiological factors. According to him the true stigmata are :—

1st. The neurasthenic headache, together with feelings of pressure;

2nd. Insomnia;

3rd. Rhachialgia and spinal hyperæsthenia, including "la plaque sacrée";

4th. Muscular debility (amyosthenia);

5th. Nervous dyspepsia;

6th. Sexual disturbances in both sexes;

7th. The mental condition of the neurasthenic, undue excitability alternating with depression, anxious feelings, lack of decision and sustained working power, etc.

According to the same author the secondary and accessory symptoms of this neurosis are vertigo, asthenopia and other troubles in the sphere of the special senses, disturbances in circulation, respiration, secretion and nutrition, hyperæsthesia, paræsthesia, neuralgia, paresis, tremor, etc.

This view appears to me a mistaken and incorrect one, as it is, at least in England, quite exceptional to find Charcot's seven cardinal symptoms present in the same patient. It is far more common that only one, two, or at most three, of these stigmata are present, while bulbar symptoms, which Charcot has almost completely ignored, are, on the contrary, extremely common, and may well be considered fundamental and typical. The urinary triad which I have described (p. 206) is certainly, if any, a "cardinal symptom" of the neurosis, while cardiac and vasomotor disturbances (p. 190) are so very frequent, that they do not deserve the secondary and accessory place which Charcot has assigned to them in his scheme.

CHAPTER VI.

THE PROGNOSIS OF FAILURE OF BRAIN POWER.

CAN heredity be modified? This is unquestionably the most important question in the prognosis of most cases of the neurosis which we have been considering, for we have seen that inheritance plays the principal part in its production. How shall a man escape from his ancestors, or draw off from his veins the black drop which he drew from his father's or mother's life?

Fortunately the *damnosa hereditas* in general is in encephalasthenia not of that overwhelming character which obtains in some forms of epilepsy, hysteria and hypochondriasis, and in most forms of insanity; and I have seen enough of the course of the neurosis to enable me to state that most cases of it are curable, unless the conditions of life are exceptionally unfavourable. Experience shows that with such remedies as strychnine, arsenic, phosphorus, the bromides, electricity, and others at our disposal, we may often successfully combat the disease; while proper directions as to diet, regimen, and the due observance of hygienic rules in their widest sense, and, finally, the assurance given to the patient that he is not suffering from any organic disease of an incurable character, will powerfully aid our therapeutical procedures.

It is true that relapses often occur when the exciting causes, which originally led to the outbreak of the malady, may have again become active, and in this respect I have found overwork, worry, and excessive mental strain at the top of the list. Yet relapses are in general more easily curable than the first attack of the malady, and often yield to treatment in a surprisingly short time.

The laws of inheritance, which have been discussed in the second chapter, however, must always make us guarded in forming our opinion on the eventual prospects of patients in whom inheritance is very marked, and where the principal symptoms occur in the intellectual sphere. In such instances the law of transmission at corresponding periods of life sometimes steps in as an evil genius when least expected.

As far as the prognosis for the special classes of symptoms is concerned, I have found that it is least good for those of the highest level, better for those of the middle, and best for those of the lowest level. In so-called "borderland cases," however, the prognosis is altogether less favourable. Not only are such patients often rebellious to treatment, but the affection has the tendency to turn into hypochondriacal melancholia. On the other hand, I have in 666 cases only twice known suicide committed, and only one patient has to my knowledge died of general paralysis, which became eventually developed. Locomotor ataxy, multiple sclerosis, or other organic diseases of the brain or cord which Arndt[149] has erroneously stated to grow on the soil of encephalasthenia, have been altogether absent in those cases the further development of which I have been able to ascertain.

CHAPTER VII.

THE TREATMENT OF FAILURE OF BRAIN POWER.

THE general rule for treatment should be to do our best in every way to strengthen and brace up the nervous force of the patient, and to avoid everything which could tend to a further lowering of the deficient power of resistance to unfavourable influences from which the brain suffers. Where a neurotic inheritance runs through families, *prophylactic measures* should be taken almost from the birth of the infant. Children should be brought up, if possible, in the country or at the seaside, away from the turmoil and impure atmosphere of large cities; for country life is not only physically more wholesome for neurotic children than town life, but seems likewise better adapted for cultivating their mental powers. Sir Douglas Galton[161] has recently demolished the common fallacy that town children are quicker and more observant than country children. According to him, the opposite is the rule, for town children have a monotonous routine of daily life, in which January is much the same as June, the streets and houses being the same all the year round; while even the dullest country children cannot help noticing the bursting of buds on the hedges, the different birds that each season brings, the change of clouds which each wind produces; so that merely expecting and looking for these changes induces a habit of observation and close attention. This quickness of perception may, indeed, not only apply to the phenomena of Nature, but also to learning; and it is therefore very important that children of neurotic parents should not be town-bred. The old saying, "God made the country, and man made the town," seems chiefly applicable to this point, and schools should for this reason be transferred from towns to the country, in order to improve the vigour of the race.

The food of neurotic children should be well adapted to each consecutive period of life, and should always be of an easily digestible and nourishing kind.

I was lately consulted in the case of a boy, aged seven, whose mother could not nurse him, and who was therefore from birth handed over to a wet-nurse. Six months afterwards it was discovered that this person had been pregnant all the time, and had had no milk at all, so that the boy was nearly starved, and had subsisted on scraps of unsuitable food given him from time to time by the wretched woman who had charge of him. He was then brought up by hand, but could not walk until he was three, nor talk till he was five years of age, after which an insidious form of spinal meningitis became developed.

The action of the liver and the bowels should be carefully watched. Fresh air is as necessary as food; and as Voit has shown that of the entire quantity of intracellular oxygen which is used in the twenty-four hours only one-third is stored up in the system during the waking condition, while two-thirds are taken in during sleep, the enormous importance of large and well-ventilated bedrooms is thereby scientifically proved.

A proper action of the skin should be promoted by baths, or by a wet rub, followed by a dry rub, in the morning. The clothing should be hygienic, and coddling avoided. Exercise should be taken in a reasonable and moderate manner, adapted to the strength of the individual, and excesses in running, bicycling, tricycling, etc., should be carefully avoided.

In addition to these factors, an all-important influence for children of neurotic parents is thoroughly intelligent training of the mind, for there can be no doubt that the educational neglect of such children tends to swell the ranks of paupers, criminals, and vagrants, of the lazy, the unemployed, the irreclaimably vicious, the habitual drunkards, the loafers, roughs and rowdies, the anarchists, and all others who are habitually conspiring against society, either consciously or unconsciously. Even in high-class schools the management of children is often unintelligent to the highest degree, tending to suppress all spontaneous action, which should, on the contrary, be encouraged and directed into proper channels by every means in the teacher's power. Unfortunately the tendency of board schools appears to be to crush all individuality of character.

Francis Warner,[162] who has for years past carried on a most laborious and painstaking research into the condition of school children, has classed those as neurotic in whom he found an abnormal state as regards expression, balance, movements of the eyes, or action of the hands and fingers. A careless and indolent attitude in the pupil is known to be not conducive to attention; while on the other hand, a well-balanced and symmetrical posture of the body, and accuracy in movement, promote brightness in the intellectual sphere.

That this should be so may be easily understood when we remember the intimate anatomical connection which exists between the pre-frontal area and the Rolandic convolutions; and the wholesome influence of judicious gymnastic exercise, games, drilling, as well as attention of teachers to the habitual attitude of school children, is thus accouted for. Warner has found that neurotic characters are by no means confined to the children of any particular class; and that, contrary to what might have been expected, the balance is rather against the well-to-do than the poor. On comparing the condition of 10,000 children in upper and middle-class schools in Kensington, Pimlico and Chelsea, with 26,000 children in the poor schools of Islington, the proportion of developmental, nutritional and nervous defects appeared to be 12·6 for the children of the upper and middle classes, and only 7·4 for the children of the poor. It is well-known that, in consequence of greater attention to hygienic conditions and improved methods of medical treatment, a considerable number of neurotic children are now brought up in every class of society, who would formerly have died in infancy. Deviations from a normal condition occur in about 20 per cent. of all the children examined, while the number of specially neurotic children amounted to 16 per thousand. Such children must, in the nature of things, be unable to hold their own against normal children in school as well as in after-life, and as they are unfit for emigration, they remain in England, and tend to deteriorate the race. The percentage of such unfit children is higher in Ireland than in any other portion of the United Kingdom, and lowest in Jewish children, at all events, in those who attend the Whitechapel board schools, and who have been expelled from Russia. Singularly enough, these Semitic outcasts show a more perfect physical formation and better mental development than English, and especially Irish children. The percentage of abnormal children in these schools was found to be as follows :—

English.		Irish.		Jewish.	
Boys.	Girls.	Boys.	Girls.	Boys.	Girls.
19·2	15·0	24·0	16·4	17·8	13·9

The average of imperfection is therefore for the Irish children, 20·2; for the English, 17·1; and for the Jewish, only 15·8.

This is a singular corollary to the fact observed in London by the author, and in Paris by Charcot, that the resident and as it were acclimated Jews, are more liable to neuroses of any description than Christians. It would, therefore, seem that residence in large towns speedily tends to deteriorate the race, more especially as far as the nervous system is concerned.

As the period of development in both sexes is in general of decisive importance for after-life, special care should be taken of children of neurotic parents during that time. Information about certain occurrences incidental to this period should be imparted in kind and guarded language by parents or teachers, and every thing done to prevent the occurrence of irregularities and bad habits.

In the treatment of adults in whom the neurosis is present, hygienic rules are likewise most important. The philosopher Kant claimed for man eight hours' work, eight hours' rest and recreation, and eight hours' sleep; and where this division of the day can be adopted it will be found to answer well. But where the origin of the trouble can be traced to excessive and exhausting labour or excitement, rest is of the greatest importance. Baneful habits which may have been indulged in must be discontinued. The meals should be carefully regulated. Smoking and drinking in the early part of the day is rank poison for such persons, and should never be allowed even where the patient craves for stimulants and narcotics in order to deaden his wretched sensations. Excesses in the pleasures of the table, and all other improper indulgence should be avoided. Smoking in moderation may be allowed to those who are fond of it, and with whom it seems to agree; but it should be forbidden altogether in the morning, and prohibited in cases where there is a tendency to cardiac neuroses.

As a mental tonic nothing is equal to work in which the patient takes a wholesome interest, avoiding unduly prolonged application, and above everything hurry in doing it. Periods of relaxation by travelling and change of scene are of great value. Long-continued "globe-trotting" and hotel-life, on the other hand, are apt to unsettle the brain. Hilly or mountainous air is, as a rule, more beneficial than sea-air. It is well to know that no English or foreign Spa has any specific influence on the condition; while mild hydro-therapeutic procedures are often useful.

Special care has to be taken with girls and women who may be predisposed to the neurosis. Factory girls and many other working women are apt to suffer through excessive hours of labour, monotonous work, and unwholesome surroundings; and, unfortunately for them, it will be generally found difficult or impossible to change their conditions of life. In women of the better classes, one of the chief exciting causes of the neurosis is *nursing of sick relations*, of which I have already spoken in the second chapter; and the family doctor should in such cases cry, "Hands off!" as soon as the slightest symptoms of brain-exhaustion make their appearance in volunteer nurses during a protracted illness in the family.

During the period of menstruation girls and women who are neurotically predisposed should be particularly careful; this holds also good for pregnancy, the puerperal state, lactation, and the menopause. Prolonged lactation should be discouraged.

Medicinal Treatment.

The medicinal treatment of encephalasthenia must be regulated in consonance with the fact that all symptoms of the neurosis bear the character of either undue excitability or of want of power. We must, therefore, for combating them, employ two classes of remedies, viz., those which lessen excessive excitability, and those which directly impart force.

Bromides.

At the head of the former class of remedies stand undisputably the bromides, which are in many cases of this kind actually indispensable, as there are no other medicines which act with equal certainty and quickness. Albertoni has shown that potassium bromide given to dogs diminishes the excitability of the sensori-motor centres of the brain to such an extent that it is impossible to produce convulsions by electrical and other stimulation of the Rolandic convolutions. The same drug likewise lessens the functional activity of the other portions of the brain, yet does not disturb their relations to one another, and for this reason is greatly superior to opium and alcohol, which likewise diminish cerebral activity, especially when given in large doses, but are apt to produce mental disorder by disturbing the even tenour of those relations, besides which they derange the action of the stomach and the liver. Irritability of temper, light-headedness, vertigo, loss or impairment of self-control, chaotic feelings in the brain, exaggerated introspection and self-consciousness, insomnia, and other similar symptoms are indeed more effectually relieved by potassium bromide than by any other medicine; while imperative ideas and the different forms of morbid fear, are not so much influenced by it. When this drug disagrees or seems to be slow in its effects, the sodium, ammonium, or strontium salts may be substituted for or combined with it. Camphor is likewise a valuable medicine for symptoms of over-action.

The dose of the bromides must depend upon the individual aspect of each case; and they must never be given for any length of time. Persistent use of these drugs is necessary in many forms of epilepsy, but in encephalasthenia they should be discontinued as soon as they have done their work; for if they are unduly pushed, symptoms of bromism may supervene, in which weakening of the mental faculties and of the walking powers is apt to play a prominent part. The bromides may often be combined with nux vomica or strychnine, the citrate of iron and quinine, belladonna, and other drugs for which there may appear to be special indications.

In those rare cases where these drugs disagree or fail to give relief, we must employ other sedatives, such as cannabis indica, hyoscyamus, hydrocyanic acid, lupulin, etc. Cannabis indica is often useful in mental depression, and when various kinds of fear disturb the patient's composure. It is also a good sedative in the irritative form of nervous dyspepsia, where it may be usefully combined with small doses of nitrate of silver.

Opium and Morphine.

Opium and morphine were formerly considered to be the sheet-anchor in cases of this neurosis, especially in the various kinds of fear and panic, such as agoraphobia, etc.; but it was eventually found that even the temporary relief which these drugs give in such cases is not great, and that the doses had presently to be so much increased that morphinism was induced. Opium, like alcohol, not only lessens the functional activity of the brain, but likewise disturbs the relation of the different groups of neurones with each other, altering the rate at which impulses pass backwards and forwards, or interfering with the direction in which such impulses habitually travel, so that it causes not simple diminution of activity, but rather a condition like delirium.

For this reason it is easy to comprehend that in cases where the action of the neurone is already disturbed, either by undue excitability or loss of power, opium is liable to do more harm than good. In some cases, however, where patients are so tortured by fears and panic that they are near committing suicide, hypodermic injections of morphine may be given, and for internal use the extract of opium in full doses. Where there is sexual excitement, the same preparation may be given in suppositories.

Cocaine.

Cocaine is a stimulant which produces an immediate condition of euphoria, more especially when hypodermically injected;

but the exhilarating effects of the drug are generally short-lived, and cocainomania is easily induced in neurotics. This appears to be a still more stubborn and obstinate condition than morphinomania. In large doses cocaine has a paralysing influence on the brain, selecting chiefly the centres of equilibration.

Alcohol.

Alcohol is a double-edged weapon in most forms of this neurosis, for while its immediate beneficial action in cases of prostration and morbid fears is very remarkable, its remote effects, where it is used in excess, are as bad as those of morphine and cocaine. Fielding called wine a turncoat—first a friend and then an enemy. Excesses in wine or spirits may, indeed, not only lead to delirium tremens and dipsomania, but also to various forms of neuritis, especially to what is known as alcoholic paraplegia, and to sclerosis of the brain-cells, and of the glandular structures of the stomach and liver. Hypochondriacal melancholia, delusional mania, and dementia, are thus often the consequences of spirit-drinking. A glass or two of claret or still Moselle mixed with an effervescing mineral water, or some Pilsener beer, however, are in general unobjectionable, and useful where there is loss of appetite.

Amylenhydrate.

For the feelings of morbid fear and imperative ideas I have found occasional doses of amylenhydrate useful as a temporary sedative when the sensations are exceptionally distressing.

Hypnotics.

Hypnotics, such as hydrate of chloral, paraldehyde, trional, tetronal, sulphonal, *et hoc genus omne* are occasionally necessary when the patient is actually worn out with loss of sleep; but their habitual use has the same bad consequences as morphine cocaine, and alcohol. Of all hypnotics, chloralamide appears to produce a sleep which most resembles natural sleep, and from which there is not that abrupt and sudden awakening which takes place with many of these drugs, and which resembles the sudden stoppage of a railway train by the application of the Westinghouse brake. A hydro-faradic bath is, in general, preferable to all medicinal hypnotics.

Other Remedies for Hyperæsthesia.

In some forms of hyperæsthesia, phenacetin proves most useful; while antipyrin and antifebrine should be avoided where the general health is feeble.

In pseudo-angina pectoris, the inhalation of nitrite of amyl, or the internal use of nitroglycerine or erythrol tetranitrate are useful; but great care must be used in administering these agents, as they sometimes lead to intense vertigo, and to collapse.

Irritative Dyspepsia.

Regurgitation of food must be combated by insisting on the patient eating slowly; for when he bolts his food the undue excitability of the terminal branches of the vagus is still further increased. In most cases starchy food should be avoided, and an albuminous diet enjoined. As this condition is often combined with excessive secretion of hydrochloric acid in the stomach, the alkali of the saliva is at once neutralised when amylaceous food enters the viscus, and digestion of it is thus arrested. The pylorus being in such cases spasmodically contracted, the passage of starchy food from the stomach into the bowel is prevented, and the food may be thrown back through the cardia in order to undergo fresh insalivation. Regurgitation has, therefore, in certain cases to be looked upon as a natural corrective of indigestion. Excess of hydrochloric acid in the gastric juice is generally treated with large doses of potash, soda, or Carlsbad salts. It should, however, be remembered that the excess of acidity does not constitute the disease, but is only a symptom of it; and our chief endeavour in such cases should be to calm the undue excitability of the terminal branches of the vagus, and of the gastric centre in the bulb. If alkalies, such as those mentioned, are given in large doses, and for a prolonged period, they often do more harm than good by impoverishing the blood. Sulphate of soda especially seems to have a truly poisonous effect in some neurotics. For the same reason the mineral waters of Carlsbad, Marienbad, and Kissingen prove occasionally prejudicial in asthenic cases, and may, where this idiosyncrasy is marked, induce a state approaching that of hypochondriacal melancholia.

The Treatment of Paresis.

In all forms of paresis nerve-tonics are indicated, either by themselves, or combined with sedatives where such may appear desirable.

Arsenic.

The most generally useful of all nervine tonics is arsenic, under the influence of which many patients improve day by day in the most marked manner. It seems to give direct strength to the brain, which must be owing either to some peculiar and specific influence of the mineral on the nutrition of the neurone, or to lessened oxidation and catabolism in the same. This latter view is supported, partly by what we know about the habit of arsenic-eating which obtains in Styria, and partly by physiological experiment. Arsenic has been used from time immemorial by the common people in Styria as a strong tonic. The men who take it habitually, thrive on it, and are by this means enabled, not only to do much more ordinary work than others who have no such habit, but also to act with the greatest ease as guides in mountainous excursions, during which they experience no fatigue or breathlessness. Indeed it is the dyspnœa which is habitually caused by climbing that often induces the men to take to the habit; and arsenic would therefore seem to be a tonic for the respiratory centre in the bulb. The men are generally vigorous, and often reach a great age. The women in the same locality, on the other hand, take the mineral chiefly in order to get *embonpoint*, for which reason it is also given to horses and rabbits. The fact that fat is found to accumulate under its use, especially where little exercise is taken, seems to show that oxidation is retarded. Moreover, Schmidt and Stürzwage have shown by physiological experiments that arsenic diminishes the elimination of carbonic acid; and Rabuteau and Lolliot have found that it lessens the excretion of urea by as much as 60 per cent. It is therefore seen that arsenic retards the combustion of carbo-hydrates as well as of nitrogenous matters. Now the feeling of fatigue after exertion is known to be due to increased oxidation of the muscular fibre, in consequence of which keratinic and lactic acids accumulate in the muscles. If, therefore, oxidation is lessened, and only little acid is formed, we can understand why exertion should be rendered easier; while the diminution of carbonic acid in the blood diminishes the necessity of breathing, and therefore prevents panting and breathlessness. Clinically we find that arsenic increases the appetite, soothes gastric irritation, cures many forms of neuralgia, and renders the pulse fuller and stronger. It is also a bactericide of uncommon power, being more effective in chronic malarial poisoning than quinine, and is of great use in some forms of auto-intoxication.

Phosphorus.

Phosphorus ranks next in value to arsenic, and proves particularly beneficial where the intellectual sphere is suffering, with inability to work, and impaired memory. It may be given, as the mineral, in pill, or as phosphide of zinc. The hypophosphites have a slighter therapeutical value, but are less liable to disagree than the mineral in its unoxydised form.

Strychnine.

Another nervine tonic of great use in the paretic form of encephalasthenia, is strychnine. This alkaloid has, like arsenic, a directly bracing influence on the neurone, and thereby improves the functional activity of the intellectual sphere as well as of the lower centres. While alcohol paralyses the vasomotor centre, strychnine, on the contrary, increases its tone and reflex excitability. The general blood-pressure rises through the action of the drug, and it is therefore of great use in paresis of the vasomotor and other centres in the bulb. It has a similar influence on the respiratory centre, for the respirations become quicker and deeper, and more respiratory work is done. The sluggish and sighing inspirations which are found in paresis of the respiratory centre, are replaced by a more healthy and automatic breathing, and more oxygen is consequently absorbed. Strychnine also stimulates the cardiac centre, renders the contractions of the cardiac muscle slower and more powerful, and removes any irregular type in the heart's action. It is therefore an excellent remedy in anarchy of the heart and analogous conditions. Finally, it has a powerfully stimulating influence on the gastro-intestinal centre, and enables the muscular coat of the stomach to contract, in cases of the atonic form of nervous dyspepsia, where the fundus is, by loss of power, prevented from breaking up the food and mixing it well with the gastric juice. It has also an excellent influence on the muscular coat of the bowel. Unfortunately it disagrees so much with some patients of this kind that its use has in them to be discontinued.

Other Tonics.

Caffeine has an analogous action to that of strychnine, but is in general inferior to the latter, except in its effect on the cardiac centre, on which caffeine has a remarkable although temporary influence. Other cardiac tonics, which are chiefly of use in paresis of the cardiac centre, are digitalis, strophanthus, convallaria majalis, and adonis vernalis.

In paresis of the vasomotor centre, ergotine is often helpful, as it tends to increase the tone of the muscular coat of the blood-vessels by its special action on that centre; while in atony of the gastric centre, and the atonic form of dyspepsia resulting therefrom, nux vomica or strychnine, with bismuth, may be given before meals, and hydrochloric acid—of which there is an insufficiency in the stomach in that condition—after meals.

Cerebrine Alpha.

Another nerve-tonic which may be used, more especially in cases of loss of power, is a sterilised extract prepared for me by Messrs. Brady and Martin, of Newcastle-on-Tyne, from the brains of healthy young animals, and which I have called Cerebrine Alpha. A paper giving my experience on this subject has recently appeared in the "Lancet."[163] In this place I will only say that I consider cerebrine alpha hypodermically injected to be a nervine tonic of considerable efficacy in certain conditions mainly characterised by loss of nerve-power, and a valuable addition to our older nervine remedies, with which it may often be used in conjunction.

A gentleman, aged 60 years, who had been neurotic for many years, was under treatment with this extract when several grave misfortunes happened to him, viz., loss of a large sum of money, and the serious illness of his wife and daughter. While formerly under similar circumstances he would have been completely prostrated, he was able to go on with his work, and although he keenly felt the distress caused by these events, he never lost his self-control. Another patient, a man aged 42 years, whose thoughts had for some time past been running on hardly anything but the various forms of committing suicide, the pros and cons of which he used to discuss with himself night and day, found after two injections that these thoughts did not come so readily to him, and he eventually became altogether free from them. A gentleman aged 76 years, who had been neurotic almost all his life, and had suffered chiefly from gastrodynia, spasmodic asthma, and fits of depression, wrote to me about a week after the first injection: "You will hardly believe me when I tell you that within forty-eight hours after your operation I was quite another man, and have remained so ever since." Suggestion will no doubt by many be credited with such a result, but the patient who wrote these and other much more significant words, which I suppress, was a well-known man of the most brilliant and highly trained intellect and the keenest analytical powers, which neither age nor infirmity had been able to blunt; and he had previously used numerous other modes of treatment which appeal far more to the imagination than such a simple thing as a hypodermic injection.

My observations on this point have led me to the conclusion that the action of cerebrine alpha is twofold. In the first instance it may be looked upon as a highly specialised pabulum of nervous matter in consequence of its containing protagon, cerebrine, and lecithine; and, in the second place, it appears to act as an antitoxine, as the phosphorised bodies split up, under the influence of the alkalinity of the blood, into glycero-phosphoric acid and choline, which have the power of stimulating intracellular oxidation and the elimination of leucomaines. At the same time it must be confessed that the action of this extract is uncertain, and that cases occur which appear to be rebellious to it. If after half-a-dozen injections no decided improvement is seen to follow, it is better to resort to some other treatment. My observations on this point have led me to the conclusion that in a certain proportion of cases there may be a deficiency of lecithine and other highly organised compounds in the brain which are supplied by the injection, while in others no such deficiency exists, and therefore no improvement can result from introducing an excess into the system.

ELECTRICITY.

The principal remedy, and one which is of truly inestimable value in the treatment of the neurosis, is electricity. No other agent has such a direct and immediate influence in improving the tone of the neurone, and subduing distressing symptoms dependent either upon paresis or hyperæsthesia, as the constant galvanic current properly administered. In the treatment of morbid fears, more particularly, this agent cannot be replaced by any other. I have often been sorry to find that in many such cases "self-discipline" has been the only thing recommended to the patient, as self-discipline without extraneous help often implies months and even years of torture, and entails inability to work, and financial ruin to the sufferer and his family. If electricity fails to relieve such persons, this is very often owing to the inefficient and haphazard way in which it is administered.

There are several points of the greatest importance for an electric treatment to be carried out successfully, and which should be carefully weighed before it is resorted to in such cases.

(1.) *The Instruments.*—The following instruments are indispensable: (*a.*) a good constant battery, the current of which does not vary perceptibly for some months or years; (*b.*) a properly constructed rheostat which allows of a very gradual increase and diminution of the current-strength without interruptions, and consequently without shocks; and (*c.*) an absolute galvanometer, showing the passage, direction, and power of the current. For obtaining the battery current I recommend a stationary Leclanché arrangement, say of 40 cells, which keeps in good order for three or four years without being overhauled. The best rheostat is that devised by Lewandowsky and Leiter, and the best galvanometer the large instrument of Edelmann, which shows with perfect accuracy the passage of any degree of force between $\frac{1}{10}$th and 800 milliampères, as well as the direction of the current. Where the battery is powerful, a chain of two or three rheostats is advisable, in order to be able to apply minimum current-strengths in susceptible persons. I am in the habit of using three rheostats in the circuit, by means of which an almost infinite variety of different shades of electric power may be obtained.

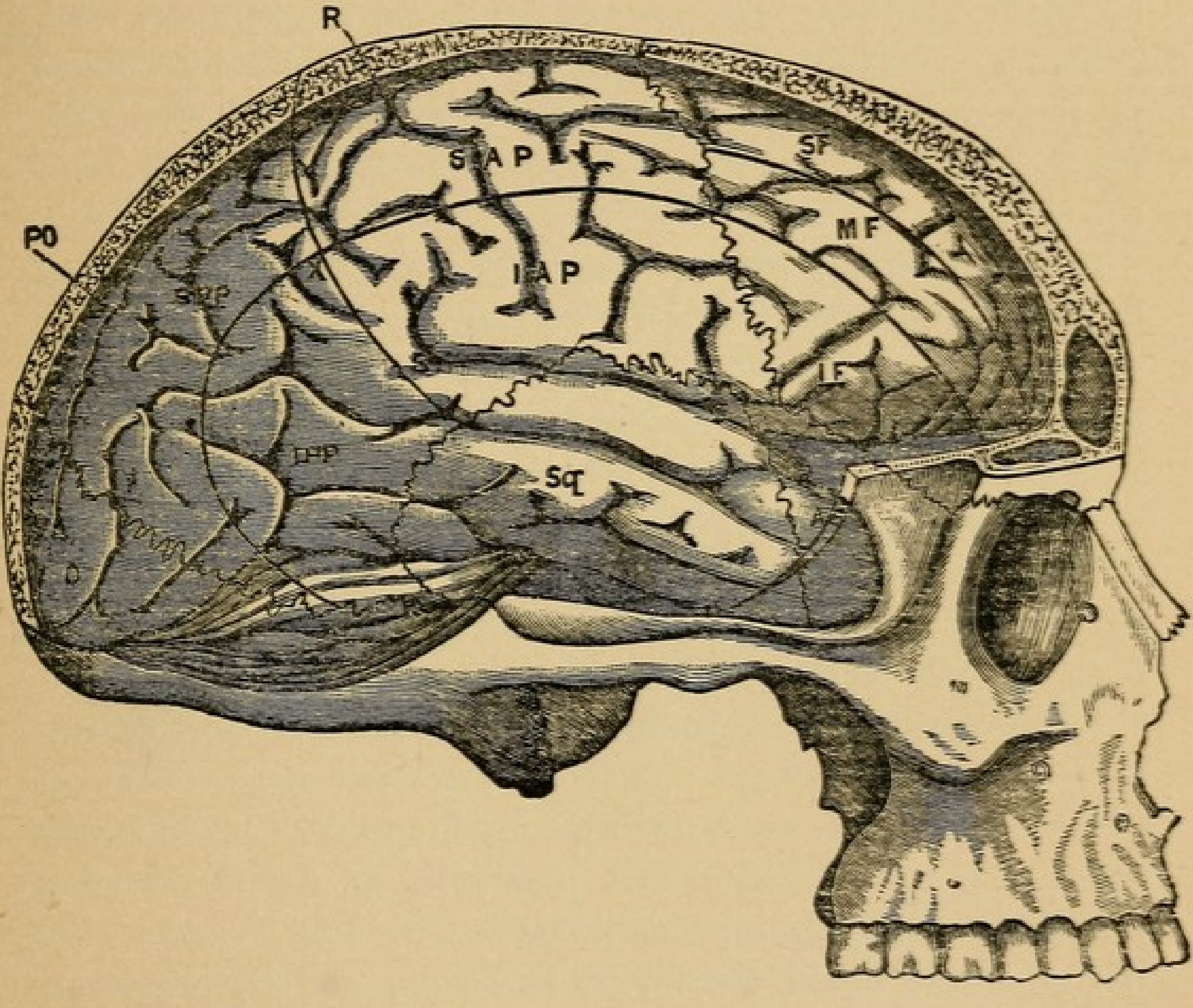
Great attention should also be given to the rheophores and electrodes, as looseness in their use is apt to jeopardise the result of the treatment, by causing sudden interruptions of the current, in consequence of which flashes of light, noises in the ears, giddiness, and other unpleasant effects are caused. I cannot repeat too often that, while electricity is an obedient and faithful servant to those thoroughly conversant with the laws which rule it, it is apt to cause very unpleasant surprises to the ignorant and careless.

(2.) *The Diagnosis of the Case.*—Supposing that the battery and all its appurtenances are in perfect order, the next point which claims attention is the mode of application. The principle which has to be followed throughout in using electricity for therapeutic purposes is, that the current should be applied to the seat of the disease. Where pain or paræsthesia in an arm or a leg are owing to cortical troubles, they will never be vanquished by electricity applied to the peripheral part where such morbid feelings may be experienced. The diagnosis of the localisation of the trouble which may be under notice is, therefore, of cardinal importance for the successful treatment of it, and in no disease more so than in the neurosis which we are now considering. A consideration of the localisation, which I have attempted to give in the second chapter, will thus be the best guide for selecting the place to which the electrodes should be directed in an individual case.

The exact relation of the convolutions and fissures of the brain to the surface of the skull are shown in Fig. 16 (after Sir William Turner).

In this diagram R indicates the fissure of Rolando, which separates the frontal from the parietal lobe; S S the fissure of Sylvius, which separates the temporo-sphenoidal from the frontal and parietal lobes; S F, M F, and I F, correspond to the superior, middle, and inferior frontal convolutions; O is

FIG. 16.



the occipital area of the skull, indicating the position of the occipital lobe, the latter being placed on the middle occipital convolution; P O is the fissure between the parietal and occipital lobes; S A P corresponds to the superior portion of the sensori-motor centres of the hemisphere, A P being placed on the ascending frontal convolution, and S on the ascending parietal convolution; I A P corresponds to the inferior portion of the same area, A P meaning the ascending frontal and I the ascending parietal convolution; S P P indicates the superior and posterior portion of the parietal area of the skull, the letters being placed on the angular convolution; I P P shows the inferior and posterior portion of the same area; X the supra-marginal convolution; Sq indicates the squamoso-temporal region of the skull, which contains the larger part of the temporo-sphenoidal convolutions; and A S the sphenoid area, containing the lower extremity of the temporo-sphenoidal lobe.

The application of the electrodes should be as much as possible in consonance with these topographical indications, where we are able to localise the affection in a definite area of the brain.

(3.) *Current-strength and Length of Application.*—As I have found asthenics in general to be extremely sensitive to electricity, and unable to bear more than a slight force, especially in the beginning of the treatment, it is advisable to commence with the lowest strength at our disposal, and to increase this very gradually until the current becomes plainly perceptible. An excess of force is extremely hurtful in this condition, and the best degree is that where nothing more than a slight sensation of pricking and heat is perceived.

It has been recently stated that "less than one milliampère can do no good." Such an assertion shows want of experience. I have not unfrequently found patients so highly susceptible to electricity that one-tenth or two-tenths of a milliampère were all they could comfortably bear. Any higher degree would cause discomfort and pain, and is, moreover, unnecessary, as the slight doses which I have just mentioned have in such cases been quite sufficient to do good.

The most important modes of galvanising the brain are the following:—

1. The *anterior association centre*, or the pre-frontal area, should receive the galvanic influence in cases where self-consciousness is exaggerated or perverted, self-control deficient or wanting, personal initiative and decision absent or diminished,

and where it is difficult to fix the attention. The polar effects are here of the greatest importance; and anelectrotonus should be produced where we have to do with symptoms of over-action and undue excitability, while catelectrotonus is employed for combating the condition of paresis. A flexible electrode, 10 inches by 3, is placed to the forehead, and connected, according to the special circumstances of the case, either with the positive or the negative pole of the battery, the circuit being closed by the opposite pole connected with the hand. Current-strength, according to individual susceptibility of the patient, from one-tenth to two MA's, and length of application from one to five minutes. Daily applications for some time.

2. The *meso-cephale*, or mid-brain, should be acted upon where the emotional centres are affected, and such feelings as despair, hopelessness, alarm, want of confidence, panic, and the different forms of fear, such as agoraphobia, etc., are prominent symptoms. For this purpose I am in the habit of using two different modes of application, giving preference to that which may be found to be most effective in a given case.

a. Round electrodes of about two inches in diameter are used, one being placed just above the right, and the other above the left squamoso-temporal region of the skull. Current-strength from one to three MA's, and length of application from two to seven minutes. As the meso-cephale also contains centres for the maintenance of the equilibrium of the body, the greatest care should be taken, when the application is finished, to let the current out gradually, as with a rapid break of it a feeling of severe giddiness would be caused.

b. Another useful method of acting on the emotional centres is to send the current *through the eyes*, which, on account of the very large percentage of water contained in the lens and the vitreous body, are excellent conductors of electricity. The active electrode is placed on the closed eyelid, while the indifferent one is in the hand of the patient. The current now runs along the optic nerve and tracts to the optic lobes and pons Varolii. As conduction is much facilitated by the circumstance just mentioned, ½ MA is generally ample for this proceeding. Each eye should be done separately, for from one to three minutes.

3. The *posterior association centre* has to be acted upon whenever the normal interpretation of external impressions is suffering, and where the thinking power is more or less in abeyance, with absence or flight of ideas, and foolish notions on persons and things. It is somewhat difficult to act upon this centre in persons with luxuriant hair, and easier in those who are bald, or whose hair is thin. The parietal and occipital region of the skull should be galvanised, as the parietal and the anterior portions of the occipital convolutions constitute the main portion of this centre. A large flexible electrode, as in No. 1, should be successively applied to the parietal and occipital region, anelectrotonus or catelectrotonus being induced according to the special circumstances of the case; and the circuit is closed by an indifferent electrode placed in or on the hand of the patient.

4. *The bulbar centres* for respiration, the heart's action, digestion, urinary secretion, etc., should be galvanised where we have to do with such conditions as distressing palpitations, failure of the heart's action, tachycardia, and bradycardia, vasomotor spasm or paresis, spasmodic asthma, morbid changes in perspiration, irritative or atonic dyspepsia, polyuria, phosphaturia, glycosuria and functional albuminuria, some otherwise intractable forms of dysmenorrhœa, etc. I am in the habit of employing two different methods for acting electrically upon the bulbar centres, which are as follows:—

a. The anode, five inches by two, is applied to the cervical spine, while a round cathode of two inches in diameter is directed to the region of the superior cervical ganglion, at the angle of the lower jaw. 1 to 3 MA's, and from one to three minutes to each side of the neck.

b. In cases where the symptoms of irritation are overwhelming, it is better to have the cathode at a distance from the bulbar centres. The anode is then applied to the cervical spine as before, and the cathode to the hand. From 1 to 5 MA's, for ten minutes.

Some of these different modes of applying the constant current may be usefully combined, but it is important not to make the whole application too long. In general the maximum, beyond which it is well not to go, is ten minutes.

The foregoing methods of electrical treatment are the outcome of many years' special work and experience on my part; and if carefully followed, will yield as brilliant results in the hands of others as they have done in mine. By means of these methods I have succeeded in restoring to health a large number of patients whose cases appeared almost desperate, considering the severity of the symptoms, the length of time the illness had lasted, and the variety of other treatment to which they had previously been subjected. In most cases of the neurosis, the treatment which I have advised is indeed *facile princeps*, and acts *cito*, *tuto et jucunde.*

For further information on these matters I must refer the reader to my works on electro-therapeutics.[164]

Faradisation and Franklinisation have been recommended for the treatment of the neurosis, but I have found the constant current so very much superior to both in its effects, that I have ceased to employ other forms of electricity in this neurosis. Apostoli,[159] has again quite recently recommended static electricity by means of the bath, the breath, and sparks taken from the spine, in hysterical cases; and cellular currents, or currents of high frequency, for the arthritic variety.

Hypnotism.

I have been led to form an unfavourable opinion of the therapeutical value of hypnotism in these cases. I have myself, some years ago, subjected a number of patients, whose cases were rebellious to other treatment, to hypnotic procedures, but always found that there was great difficulty in inducing artificial sleep in them, nor have I ever seen the slightest beneficial effect from the use of hypnotism. I have also occasionally sent patients to hypnotic specialists for treatment, with the same result. This experience agrees with the opinion expressed by Charcot and many other neurologists on this point.

Weir-Mitchell Treatment.

A far more efficient system is the Weir-Mitchell treatment, which consists of seclusion of the patient under the despotic care of a nurse, massage combined with Faradisation of the muscles, and over-feeding. This therapeutical system seems chiefly adapted to those forms of the neurosis which occur in clever, emotional, and excitable women, who suffer from such constant weariness and fatigue that they eventually throw up the sponge, and pass their life on the sofa or invalid chair, eating next to nothing, wasting away, and being in a very unwholesome mental condition. Playfair and others have seen excellent results from it in a considerable number of such cases ; and I have personal knowledge of the beneficial effects of the treatment in cases of hysteria. Most asthenics, however, are men, who will not readily submit to isolation, etc., and it must be confessed that the inconvenience which this treatment entails on the patient submitted to it, is often extreme. For this reason I should under any circumstances recommend the practitioner, before resorting to Weir-Mitchell, first to give a trial to one or another of the electrical methods which I have advised.

The End.

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