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The Harveian Oration ON "INVENTIONS AND THE OUTLOOK IN NEUROLOGY"

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BY

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For us, his posterity, Harvey is the first to pick up the threads of experiment and observation begun by Galen in the correct deductions from his lesions of the spinal cord in frogs and rabbits, continued by Aristotle, and thereafter broken for 1,500 years, and he is styled the "Father of modern physiology." From the manner of his work in experiment and in observation of proofs he is the inventor of modern methods of research. From the law which he laid down of "Omne vivum ex ovo" he is the starting-point in the idea of evolution. From his inspired flight of thought expressed in the words "Epidemic, contagious, and pestilential diseases scatter their seeds and are propagated to a distance through the air and in hidden fashion silently multiply themselves by a kind of generation" he is the prophet of bacteriology to come. He is the discoverer of the circulation of the blood. To his colleagues and to his patients he was the "beloved physician," and in this College he receives homage upon each St. Luke's Day as its most illustrious Fellow.

Harvey's exhortation to us is "To search out and discover the secrets of Nature by experiment and observation." The first experiment is in a flight of thought; a wandering of the mind which begets a sudden new idea, a flinging away for the moment of all we have taken on trust as gospel, or sometimes an attempt to explain in words to others what we ourselves do not understand, has brought discovery. No one ever made successful experiment but he had already conceived that something would happen from it, nor an invention without the idea as to how it would work. However much Harvey may have denounced mere speculation in others, yet guided by his careful observation it was his primary method of work. He had, surely, a firm conviction that the blood did circulate, and in a certain way before he put his experiment into being. He had surely conceived that the "to and fro," "ebb and flow" movements of the blood, which had been gospel since the time of Galen, could not be, and was driven by dissatisfaction to make his great discovery.

There is no method in discovery; sometimes there appears to be a high element of fortunate chance. Great knowledge is not always essential; at times it seems a hindrance to personal progress, for much of a very wide knowledge is of necessity taken on trust without even reasonable personal analysis. A castle builded in the air by a highly knowledgeable fancy in the course of a week-

end of leisure, and a lifelong plodding with microscope and stains, have both on occasion brought an equal advance in medicine, though the labour entailed in the two events is so unjustly different. It is remarkable that in former times, when knowledge of medicine was scant, the pioneers, in expressing their brief views upon physiology and disease, and particularly in teaching their pupils, gave explanations that would sum up in a nutshell our accepted knowledge of the present day after a century of discovery and proof. Such flights of thought, such lucky hits upon the real truth are, I submit, dismissed by posterity as dreams without discovery and without appreciation of their greatness. They are in reality potential discoveries not followed up, probably from lack of continuing interest, certainly from the lack of methods and of knowledge as to how to find proofs. In attempting to hold your interest upon inventions and their effect on the progress and present outlook in neurology, I shall draw your attention to several prophetic flights of thought, all of which were great, and some of which resulted in important advances in knowledge.

I have chosen the word "invention" as best fitting the bringing in of a new idea—an invention of the mind, which may prove to be a discovery of the truth or may fail as a false hypothesis—as well as the bringing in of a demonstrable fact or of a new method. Wonderful inventions for the study of the structure of the nervous system and tireless research have resulted in knowledge, practically complete, of the most intricate and marvellously beautiful network, with input paths leading from the outside world and output paths leading to the muscles for action, almost incredible in its extent, everywhere continuous, and so complicated that it is impossible to prove or to conceive how it works except in a few of its lower and grossly mechanical regions. This vast and solid edifice of proved knowledge of structure has added little to our knowledge of function and disease. But it is a very important little, for it is all we have, and it is concerned with the lower and more grossly mechanical regions of the spinal cord and brain stem. This quarry has been worked out, and labour in it has well-nigh ceased. Delving into the function of the nervous system by experiment has reached so high a refinement that the signals by which each part works can be made visible and audible. Always the same signals in every part alike, only more and more rapidly repeated as the message becomes stronger and more urgent, and the end-result of these fine labours is

some knowledge as to how the lower and simpler regions—namely, the spinal cord and the brain stem—work. To the greatest of living physiologists who has spent a long life in the experimental study of the nervous system, the Rede lecturer for last year, Sir Charles Sherrington, the highest and largest part of the nervous system, the brain, is still mainly a form and a series of events, and his ignorance of much of their relation bids him despair. Yet proclaiming himself an optimist, as opposed to a defeatist, he puts the question: "Will it ever be possible to understand the nervous system?"

In the recognition and distinction of the nervous diseases the past century has brought an ever-increasing and now almost complete knowledge, which does not yet, and will not, reach finality, for disease is subject to evolution and devolution and disappearance at least for a time. The causation of many of the diseases is now clear, and in recent years studies of biochemistry and virus infection have brought suggestions of what the future may discover in maladies of which we do not know the cause. Methods of treatment, though far behind those of diagnosis, are advancing, and at the moment we seem to be in possession of means of diagnosis and treatment which will surely remove the terrible diseases general paralysis and locomotor ataxy from the community. Yet the fact remains that the four most prevalent and relentless of the nervous diseases—disseminated sclerosis, progressive muscular atrophy, paralysis agitans, and most of the vascular diseases—come before us without any clue as to their cause, and without any means whatsoever of their prevention, nor even, as in the case of progressive muscular atrophy, of the slightest amelioration.

Cerebral Localization of Function

The means by which invention begins, the arousing of that lasting interest which does not rest until discovery is made, is often intangible and a thing perchance and of personality, but sometimes it has been recorded, and I may introduce the great discoveries in neurology with an instance. At the end of the eighteenth century a self-conscious lad pondered upon his disability promptly to answer in class the things he knew well, and concluded that it was because nature had not given him a fine forehead and prominent eyes. His interest in the brain and speech never thereafter left him. He became a very great anatomist of the nervous system, and he proved, by his dissection, the definite structural path from brain to muscle partly crossing in the medulla—the pyramidal path—and his proof was then and there accepted by the knowledgeable world for all time. Like Harvey, he was not the first to perceive this, but, like Harvey, he gave such proof of its truth that no one wished to deny it.

Gall's discovery of a definite pathway conveying movement from brain to muscle was the foundation of all subsequent work on the paths of function within the nervous system. In his early days he laid down the truest conception of the brain as the exclusive seat of the highest nervous functions only. By his conception of speech as a function of the forward part of the brain he was the originator of the idea of localization of function in the brain. It does not detract from the greatness of the discoveries of this remarkable man that he went over to phrenology and died discredited, torn from his high position by the prophetic denunciation of Flourens that there are no separate highest functions to be localized in the brain, but that all are interwoven. Round Gall's conception of cerebral localization such a war was waged during the nineteenth century—complete defeat at first, then, after years, complete triumph, and later, defeat not yet complete—as has stimulated more investigation and produced more useful discovery than any other event in

the history of neurology. At the moment the localization of function in the brain is presumed by our physiologists, but admittedly without means of scientific proof. The only proved localization of function is that of the conduction tracts—the input and output paths which connect the animal with the outside world.

Invention of Histological Technique

In 1835 Purkinje, an Austrian priest of gipsy family, became possessed of a microscope. In a short space of time he had discovered the nerve cell, and this discovery, added to that of Gall of the nerve tract, was the instigation of all later work. He had invented a hardening reagent, bichromate of potash, which would allow sections of soft tissue to be cut; a machine, the microtome, to cut the sections; a stain, carmine, which would bring out the details; a clarifying reagent, oil of cloves, which would make microscopical examination possible; and a method of making permanent preparations with Canada balsam. Purkinje's work was epoch-making in the progress it caused. As the fruits came at once the establishment of the cellular theory of tissues from Schleiden and Schwann, and the cellular pathology of Virchow. Rosenthal demonstrated that the nerve tract was made up of fibres springing from the nerve cell, and Schwann found the insulating sheath which protects the nerve fibres. Waller, by his methods of degeneration, commenced the tracing of the nerve tracts within the nervous system.

Thereafter, with the wonderful discoveries and patient work largely of the German School, in which the names of Weigert, Edinger, Cajal, and Golgi are prominent, the structure of the nervous system has been made known with such delicacy of detail, such intricacy of connexions, such enormity in amount, as to be altogether outside the possibilities of present-day comprehension of the relation of structure to function except in its lowest and least complicated regions. It is referred to nowadays as one entity, "the nervous network," just as it was first named the "sensorium commune" a century and a half ago.

Discovery of Reflex Action

In 1784 a professor of anatomy in Moravia wrote a very short account of the nervous system, and in attempting to explain how it worked said that "physical and mental stimuli acting upon ascending nerves are conveyed directly through the ganglia and network of nerve threads, to be reflected thence by means of descending nerves with a result in action." This wonderful discovery in thought of reflex action, arrived at so far as we know without definite experiment, is the foundation of most of what we now know concerning the way in which the nervous system works. I will ask you to compare these words of Prochaska with those of Sir Charles Sherrington in the Rede Lecture for last year: "Brain and nerve are but a skilfully laid train of powder between the muscles it fires and the restless world outside which fires it. The question, who pulls the trigger, is easily answered. It is the outside world." And again: "An animal's motor behaviour where the brain nets are large excels in variety and nicety, but it fails to offer anything radically different from reflex action elsewhere." By actual experiment Sir Charles Bell at the Middlesex Hospital, Magendie in Paris, and others discovered the function of the spinal roots as input and output paths by which reflex action is carried on, and Bell most importantly first conceived of the long reflex processes which went as high as the brain. Now all unconscious action is reflex action. The great Pavlov and others have shown us how large a part reflex action plays in conscious action and behaviour.

It is when we arrive at those processes in the brain which are not traceable to outside stimuli and cannot be reduced to the principle of reflex action that our knowledge of the working of the mechanism fails rapidly and finally. I may perhaps give you a simple example of the utter dependence of high cerebral function upon a reflex process. When I speak to you my speech does not flow out from well-trained speech centres in the brain as does water from a full cistern. I must have an immediate and delicate reflex return reaching me by my ears and by the sensation of movement of my lips, which keep me instantly informed as I go along that what I am saying is in correct pattern. If anything blocks the path of both those reflex actions I shall not be able to finish even a sentence, my speech, though long practised, will break down at once into an inarticulate jargon in which both words and pattern disappear. If through a faulty attention to my reflex signals I miss out an important word, my meaning tends to become unintelligible to my listeners and my speech an imperfect function.

The Hypothesis of Nervous Function

Hughlings Jackson, who is the pride of English neurology as Harvey is of English medicine, greatly influenced and moulded the present position of neurology. In method he was the ablest deducer from what seemed to be the minimum of observation, but his chief genius was that he was a relentless dreamer, who criticized with a positive inquisition all his flights of thought, and apparently only gave to the world those which survived this ordeal, for there is hardly a thing of his which has not borne the test of time. He conceived that Nature had builded the nervous system upon the same pattern of function in its several parts: that, at the lower stations, the local requirements of the individual segments of the body were looked after, but that, at higher levels, the requirements of everything below were subserved in increasingly compound proportion; and that, at the highest levels, the nervous system was concerned with the requirements of the animal as a whole—perhaps some of these concern some parts of the brain more than others.

This remarkable conception, which arose when popular belief was convinced that centres for separate functions in the several parts of the brain were ascertained facts, is substantially the proved knowledge of the present day. The supporters of the belief in local centres of function in the brain had forgotten their parent Gall, and the simple but emphatic statement by which he was overthrown: "There are no such separate functions for localization." I may perhaps put it like this: the functions of seeing, hearing, and feeling are clearly separate so far as the nerve terminations in the eye, ear, and skin are concerned, but when a stimulus from one of these organs reaches the nervous network it becomes modified by all the other stimuli which are in-coming at the moment, and the higher in the nervous system it spreads this modification increases, so that it becomes more and more difficult to think or to speak of it as a stimulus in one isolated function such as vision, hearing, or feeling. Hughlings Jackson wrote: "I cannot conceive any function of vision apart from the function of movement."

It seems clear that the local loss of function which one sees daily from lesions of the brain is the result of the blocking of the input and output paths, and I have arrived at the conclusion that when mental defect occurs from a not too extensive local lesion of the brain it results from a block upon those important tracts which put the several regions of the brain in touch with one another, and never from lesions of the higher regions of the brain, which were formerly supposed to subserve mental functions exclusively. Therefore we have now the

vast expansion of the brain, in the words of Sherrington, "as an input and output signalling system which is newly arisen as a gigantic combining mechanism for the signals from the outside world and as a dominant part of the nervous system which tends to deal with the requirement of the animal as a whole more than does any other part."

Locomotor Ataxy and Peripheral Neuritis

One of the most remarkable discoveries in the flight of thought, and one which became a proved principle a century later, came from the distinguished founder of King's College Hospital, Robert Bentley Todd, in an attempt to explain lead paralysis to his pupils. He said: "I believe that the muscles and nerves are early affected, and that at a later period the nerves centres may become implicated. The nervous system is thus first affected at its periphery in the muscles and nerves, and the poisonous influence, continuing the contamination, gradually advances towards the centre." Recently it has been shown by Aub and others that in lead paralysis accumulation of the lead occurs first in the affected muscles, and that the poison seeps up through the nerve endings into the nerves, and reaches the central nervous system. It is now generally accepted that the nerves are protected by their fatty sheaths against the advent of poisons and infections everywhere save where the nerve endings are exposed in the extreme periphery, and that it is only in these exposed terminals that noxious agents can gain access, and that they travel by a process of seepage along the nerve filament to gain the central nervous system. Viruses that affect the nervous tissues travel in the same way, and seemingly spread universally. As the only nerve terminals exposed to the outside world are the olfactory terminals in the nose, it follows that virus infections of the nervous system must be acquired by droplet infection of the nose or by wounds which expose the nerve filaments to infection.

Dr. Todd, who was by far the greatest clinical neurologist Britain had produced until the time of Hughlings Jackson, was the first to begin the breaking up of the spinal diseases, at that time all classed as "paraplegia," by his discovery of locomotor ataxy as a distinct clinical entity. He did this with his usual vivid imagination and his customary absolute faith in his own powers of clinical and post-mortem observation. He stated that the antero-lateral region of the cord was the path for common sensibility, and that the cerebellum was the organ commanding position and posture, and that the posterior columns were subservient to the cerebellum in conducting to it peripheral impressions of position for its guidance, and he made the separation for the first time between spinal paraplegia and spinal ataxy. Todd wrote this four years before Romberg wrote his work, eight years before Russell Reynolds described the disease as "muscular anaesthesia," and eleven years before Duchenne christened it "progressive locomotor ataxy."

Lumbar Puncture

In the year 1891, and in a quiet way, came an experiment which slowly led to the most astounding progress in our knowledge of nervous disease and of its diagnosis, differentiation, and treatment. No event in the history of neurology has brought so many assets as has the introduction of lumbar puncture. Quincke of Magdeburg conceived that he might relieve the symptoms of hydrocephalus by draining the cerebro-spinal fluid. Six years previously Corning in America had drained the fluid for the treatment of tuberculous meningitis, but Quincke was the first to make his work known throughout the world. The discovery of changes indicative or characteristic of certain diseases in this hitherto unimportant

fluid soon followed, and lumbar puncture has become a routine in diagnosis and treatment.

It has given us the means of speedy relief from the agonizing pain and danger of increased intracranial pressure, the cure of epidemic meningitis, of cerebral uraemia, of bromide and barbitone poisoning, and it has given us spinal anaesthesia. It has led to the discovery of the clinical features of meningeal haemorrhage and its common cause in leaking aneurysms, to the easy recognition of the many forms of meningitis, and gives definite indications of prognosis in the sugar, chloride, and cell content. Pressure upon the spinal cord and occlusion of the cerebro-spinal space are now easily ascertained by the increased protein in the stagnant fluid, and the exact site of the pressure can be made visible by the injection of lipiodol, which is opaque to x rays. By the constant discovery of changes in the protein content of the cerebro-spinal fluid and by the presence often of large numbers of cells therein, our whole conception of peripheral neuritis has been changed from that of an affection of the peripheral nerves to that of a malady creeping upwards along those nerves into the roots and central nervous system. Lumbar puncture has shown that spirochaetal infection of the nervous system occurs at quite an early stage, and this infection often dies out. Those subjects in whom signs of infection persist in the cerebro-spinal fluid are alone liable to the advent in after years of general paralysis and locomotor ataxy, and in the early treatment of such patients with malarial infection, mercury, and arsenic we have, we think, a certain means of stamping out altogether these terrible diseases from the community.

The "Encaged" Virus

Von Economo in 1921 conceived of a virus which, gaining access to the nervous system by the exposed olfactory terminals of the nose, becomes an "encaged" virus within the nervous system with no means of getting out, and which, if not conquered by the natural processes, might remain indefinitely to cause either recurrences of symptoms from time to time or, alternatively, progressive degeneration and death of the nerve elements. On this hypothesis he would explain the varying results of lethargic encephalitis—now a permanent cure, now a series of recurrences, and often again an advancing and resistless break up of nervous function long after the initial infection and when the primary symptoms had been slight. He would explain the absence of case-to-case infection in lethargic encephalitis and in poliomyelitis as due to the fact that the virus is encaged by the time the symptoms appear and cannot get out to infect others.

Infection can only occur from carriers and in the pre-symptomatic period of these diseases when the virus is a surface saprophyte in the nose. Nicolau and Galloway at the Pasteur Institute have shown how the viruses infecting the nervous system travel along the nerve threads to the remotest parts of the nervous system, and that any peripheral nerve twig, if dissected out and placed in the nervous system of another animal, will cause infection. In the course of the universal spreading of the virus the remarkable brightly staining "inclusion bodies" in the nerve cells and the lymphocyte exudations along the nerve fibrils remain as evidence of its passage. This complete invasion of the nervous system may occur without producing any symptoms at the time.

In the case of one encaged virus—that of herpes zoster—it seems clear that a local lowering of vitality of part of the nervous system by reason of injury, exposure to cold, arsenic administration, and other causes, breaks the encagement, and the virus discharges outwards along the debilitated nerve to flower upon the skin in the characteristic shingles, and that flowering upon the skin is the

only means of continuing the species and infecting other members of the community. After that flowering the virus within the nervous system dies as does the annual plant in the garden after its flowering. But it may happen that the debilitated nerve along which the virus is able to discharge is a motor nerve, in which case the virus is unable to flower. It may, however, give rise to much commotion with lymphocytic swelling in the nerve, and this is undoubtedly the cause of many of the motor nerve paralyses for which we have hitherto had no causal pathology, the commonest being Bell's facial paralysis from exposure to cold. Von Economo's principle of an infection encaged within the nervous system, existing and producing changes, without causing symptoms or alteration of function perhaps for years, and finally destroying, is likely to bring important developments in the future. As a clinical fact it has been known for long years in the end-results of spirochaetal infection, unrecognized at its advent and symptomless perhaps for half a lifetime.

That disseminated sclerosis never appears before the age of puberty means, I submit, that it takes fourteen years or more for the pathological process to run before symptoms occur. A single transient characteristic sign of this disease, lasting but a few days, often appears as long as twenty-five years before the progressive relentless disability begins, and I suggest that the process of demyelination is all over and irretrievable as soon as the progressive symptoms are present. We are faced with the inevitable scarring which long progressive and symptomless demyelination must entail. We must find some means of detecting the subjects of this disease during the symptomless stage if we are to treat them successfully. It is a remarkable fact that while disseminated sclerosis affects the central nervous system indifferently and everywhere, its destructive potentiality falls upon the younger elements of the nervous system only, those that have been recently acquired—namely, the pyramidal path, the co-ordinating mechanism for the upright stance and the finer movements of the hands, and for the recently acquired function of speech. The older functions of the special senses with touch, pain, and temperature are never progressively destroyed.

Louping-ill in Sheep and Benign Lymphocytic Meningitis in Man

Recently accident has revealed a principle which may have an important bearing upon neurological discovery in the near future. A virus expert was working at the Lister Institute upon the disease of sheep which is called "louping-ill" or "staggers." This is a virus disease, which, entering by the usual nasal route, passes along the nerve threads to the cerebellum, and there kills every nerve cell while leaving the rest of the nervous system entirely unharmed. One day this pathologist became severely ill with acute meningitis, which was supposed at first to be tuberculous, but from which, however, he made a complete and rapid recovery. He went to America to carry on his researches upon louping-ill. Shortly afterwards two of his co-workers and two of his laboratory assistants were seized with severe acute lymphocytic meningitis, from which they rapidly recovered, and it was proved from the serological reactions and by infection of animals that the recoverable meningitis in man was due to the same virus which caused destruction of the cerebellum in sheep.

The principle is that an infection in an animal which gives rise in that animal to a definite and incurable disease may produce in man an entirely different and curable disease. We already had this principle demonstrated in the opposite sense in the virus of herpes febrilis, which in man produces an insignificant event but

when introduced into the rabbit is apt to produce a fatal inflammation of the nervous system. Nervous diseases are common in animals, and it is to the closer association of veterinary and human neurology, and the wide investigation of the two together, that we look with hope to the discovery of cause and treatment in those common nervous diseases which are at present entirely mysterious.

Toxic Absorption and Neurology

The origin of disease and of tissue degeneration as the result of toxins from bacterial infection has entirely dropped out of neurology, except in the cases of the three exotoxins of tetanus, diphtheria, and botulism, which differ entirely from the elusive factor in what is commonly referred to as toxic absorption, in that they are real, they can be isolated and put in a bottle, and their effect proved by experiment. A few years ago the origin of pernicious anaemia and of subacute combined degeneration of the spinal cord in toxic absorption from intestinal infection seemed to have good foundation on clinical and experimental grounds, but subsequent discoveries in gastric and hepatic function have swept all such ideas away, and have introduced a deprivation origin for these diseases with highly successful means for their prevention and amelioration. Toxic absorption, at present much spoken of, will probably be similarly discarded from other realms of medicine within reasonable time.

It is highly interesting that the exotoxin of tetanus, by entering into combination with the protoplasm of the nervous system, does produce a train of events identical with that of the virus of hydrophobia, by living within the nerve protoplasm; in one case the highest degree of over-function in the fatal spasm, in another a complete loss of function in the toneless paralysis just like that of severe peripheral neuritis. It is probable that the many conditions of peripheral neuritis, at present without known cause and which seem to be increasingly common among us, may be due to virus infection, and the relapsing tendency after partial recovery is like the behaviour of an encaged virus. The difficulty in this investigation is the discovery of a susceptible animal, without which we cannot find or prove a virus as the cause of disease.

Deprivation conditions are likely to prove a fruitful field in the development of our knowledge of the causes of nervous disease. We have already established that tetany, subacute combined degeneration, beri-beri, and pellagra are due to known deprivations. The pigeon fed on polished rice, and therefore paralysed almost to death, which can be restored to complete strength and action in an hour by the administration of a few drops of infusion of rice husk, is a miracle of the effect that vitamin shortage and vitamin administration can make within the nervous system. It has recently been suggested that disseminated sclerosis may prove to be a deficiency disease.

The recent discovery of Sir Henry Dale that efferent stimuli in the vegetative nervous system produce their effect by the liberation of a chemical intermediary of the choline group, and that stimulation of the sympathetic in otherwise denervated skeletal muscle results in tonic contraction, seems to me to open up the possibilities of great advance in our very scant knowledge of the pathology of the myotonias, myasthenias, and myopathies.

In the progress of neurology the all-essential labours of the physiologist and of the anatomist have almost reached finality. Much addition to the wealth of their discoveries is not to be expected in the future. The bacteriologist, similarly, seems to have added all that is possible from his researches. Not even the absorption of hypothetical toxins troubles us as a factor in the causation of nervous

disease. The clinician and his inseparable pathologist have at the present time a fertile field where regional diagnosis has become well-nigh perfect in which to carry on the separation begun by Thomas Parkinson a century ago, and to show the easy recognition of new and distinct nervous diseases. Thus the thirty years of the present century have given us subacute combined degeneration, dystrophia myotonica, amyotonia congenita, epiloia, Schilder's disease, narcolepsy, the meningeal haemorrhages, the cerebral aneurysms, the many pituitary syndromes, and other distinct and easily recognizable maladies. It is astonishing how much more common a malady becomes when it has once been well described. There is scope for a rich harvest in the future, especially in the realms of peripheral neuritis, the muscular atrophies, and the vascular diseases. The virus worker and the biochemist have probably the greatest immediate future before them, heralded by their collection of the plums of the immediate past in their researches on poliomyelitis, tetany, pernicious anaemia, and insulin. The closer association between botanical, veterinary, and human medicine which has made a beginning will, I think, have an outcome in much advance, for nervous diseases are common in animals, and have not received sufficient attention.

The psychiatrist struggles with his most difficult burden of advance almost alone. The anatomist, physiologist, bacteriologist, virus worker, and biochemist have not, as yet, done anything material to clear the path for his progress as they have for the neurologist. Just as the highest functions of the nervous system allow of no physiological or anatomical analysis, so do its disorders at present admit no pathological and causal conception. The primeval forest of psychiatry, with no pathways cleared to look around, is hard beset with an ever-growing jungle of intricate terminology. The progress of neurology in my lifetime has been amazing, and its present position is highly advanced for a civilization which Sir Grafton Elliot-Smith insists is not yet sixty centuries removed from primitive man. And yet I doubt not that neurology has but made a highly successful beginning.

In his Harben Lecture on "The Diagnosis of Small-pox and the Investigation of Vaccinia by Laboratory Methods," delivered before the Royal Institute of Public Health on October 8th, Professor W. J. Tulloch, M.D., laid down five points which should be emphasized to members of the medical profession, and by them to the public. (1) Vaccination gives complete protection against both small-pox major and small-pox minor for several years, and partial protection for the greater part of the span of life. (2) The real value of the procedure as far as the individual is concerned is that it protects against small-pox major. So far as the community is concerned its value as a protection against small-pox minor is not unimportant, for the control of the minor malady is sometimes rather costly to local health authorities. (3) There is a potential danger at least that small-pox major may gain a footing at any time in this country. (4) We owe a debt of gratitude to the neighbouring countries which do enforce compulsory vaccination. It is significant that this measure is rigidly enforced in those European lands—Bulgaria, Czechoslovakia, Austria, and Hungary—whose geographical position is such that the disease may be introduced from the East. (5) The danger of grave complications following vaccination, notably encephalitis, is very slight when the procedure is performed early in life, but it is by no means negligible when primary vaccination has perforce to be carried out during the school years. In the absence of universal and compulsory vaccination, accurate methods of diagnosis in doubtful cases constitute a valuable addition to our armament for limiting the propagation of the disease.