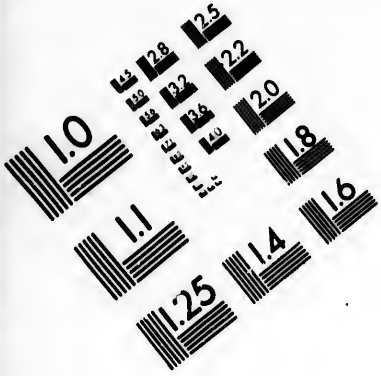

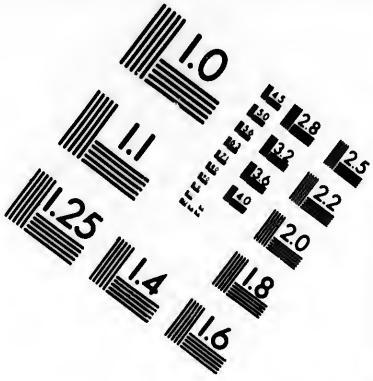

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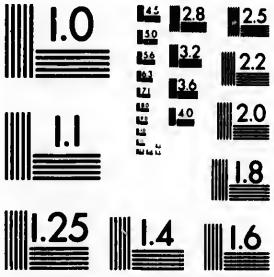

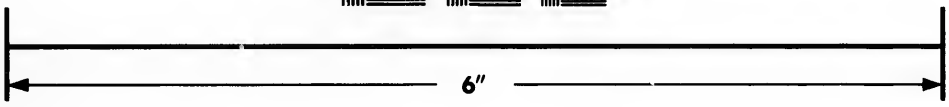

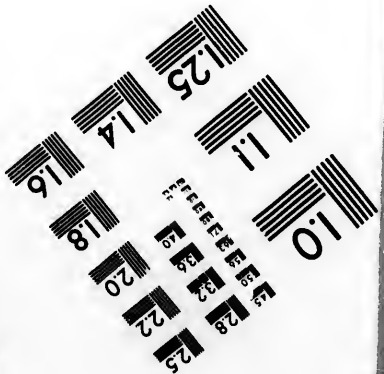

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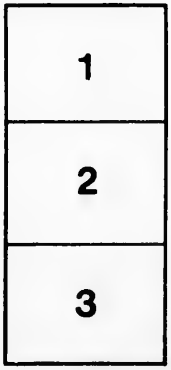

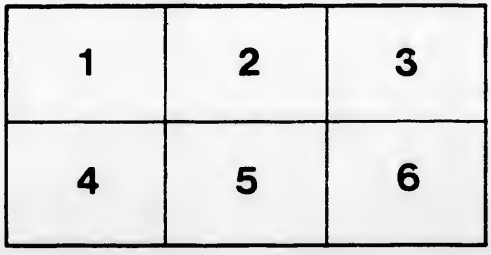

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A REPORT ON CEREBRO-SPINAL PATHOLOGY.

By DANIEL CLARK, M. D.,
Medical Superintendent Asylum for the Insane, Toronto.

[From the AMERICAN JOURNAL OF INSANITY for October, 1883.]

A REPORT ON CEREBRO-SPINAL PATHOLOGY.*

BY DANIEL CLARK, M. D.,
Medical Superintendent Asylum for Insane, Toronto.

The writer of the following paper was honored by this Association in having been selected as the chairman of a committee to report on the annual progress made in that division of medical research, classified under the head of "Cerebro-Spinal Pathology." It is a matter of regret that a more competent selection had not been made out of the many distinguished physicians composing this assembly, and whose varied contributions to medical literature have justly made them famous. At the same time, it was my duty to obey your behest to the best of my ability. My co-members were consulted and asked to contribute even a mite to my collection, but my effort was "love's labor lost." My genial and well qualified friend from the sunny south, has been otherwise engaged and prayed to be excused. My other talented supporter in the tripartite committee from the great north-west, did not answer my appeal, but as at that time the thermometer was dancing about in the neighborhood of forty degrees below zero in his locality, I am convinced he must have been in a partial condition of congelation, and incapacitated by the withering breath of old Boreas from responding to my entreaty for needed aid. I am pleased to see a thaw has taken place, and that it is not yet too late for

*Read at the Annual Meeting of the Association of Superintendents of American Institutions for the Insane, held at Newport, R. I., June 26, 1883.

him to contribute his experience to the common fund. These are two valid reasons out of a possible three for my short-comings in this epitome.

It would be impossible in a short paper to present more than a condensed view of a few of the many fields of observation, which are continually opening up in our chosen tract of exploration. These will be given in as few words as is possible.

The advancement of practical medical knowledge may not be very striking from year to year, yet, experience teaches that apparently insignificant facts may be followed by momentous results. The observations and experiments of Galen over seventeen centuries ago, on the recurrent laryngeal nerves and on the functions of arteries, led to the great discoveries of nerve function and blood circulation. The investigations in respect to the work of the lymphatics made in the seventeenth century, led to our present knowledge of their important place in the animal economy. Bell's researches into nerve structure and function, made nearly eighty years ago, were a great stride forward towards the better understanding of the workings of the cerebro-spinal economy. Magendie used Bell's data, and by adding them to his own observations, based on experiment, he came a step farther into the light of truth. Little did Tyndall dream that when he was experimenting with a sunbeam which straggled into his study, he was gathering material to prove the germ theory, and in *Listerism* revolutionized the practice of surgery. Thus it always has been and always will be—one lays the foundation and another builds on it. One isolated fact may be a key to open a door into a veritable chamber of wonders. It is never to be forgotten that theory is always to be received with caution, but experimental

knowledge carries its own evidence with it. In this lies the great advantage of pathological research. Diseased organs with the signs and symptoms consequent thereon, have been studied closely during the last quarter of a century, with all the assistance chemistry and the microscope could give to the pathologist, nor have the observers labored in vain in this marvelous field of inquiry.

Let me give a few facts of recent date on this subject, in relation to cerebro-spinal pathology. Of course, they can only be a few out of the many daily coming into observation.

In 1840, Nasse discovered that after the division of a nerve, not only was the cicatrix after healing a different texture from that of the nerve divided, but that all the nerve from the cut part to its utmost extremity had changed in character. Atrophy, degenerated myeline, fibres changed in opacity and outline were always found to be the result of division in all the cut-off nerve. Ten years later, Waller not only corroborated this, but took a step farther and showed by actual experiment that not only did this change take place, but that regeneration to the normal condition never supervened. This was a great step towards a proper study of nerve decay, and especially of insanity in relation to permanent recuperation. A breach of continuity once effected in nerve tissue, either by disease or traumatic lesion, means irreparable loss of natural structure, and as a consequence loss in some degree of normal tone and function. We know that inflammation never leaves a structure as it found it. The interosseous substance of a fracture is always different from the normal bone. A scar is a good example of change of structure, and which always remains in this condition. In the same way, so distinct

is nerve change, that we can trace its degenerative ravages throughout its most eccentric ramifications. Subsequent experiments during the past year have not only corroborated these facts, but by means of them the "centers of nutrition" have, by experiment, been found to be located in the spine and spinal ganglia. It proved an extraordinary fact, viz., that if only a certain nerve were divided by the knife or affected by disease, the degeneration only affected that nerve tract, however intimately the fibres might be bound up or interlace with each other. This explains much that seemed erratic in the pathological condition of the cord and brain. Anatomy has shown us little distinction in the composition of these two centers of nerve energy, but this cardinal fact shows us that even in apparently uniform nerve structures there do exist unknown differences in their ultimate elements. Turck, of Vienna, has shown cases of brain disease in which certain definite tracks commenced at morbid centers, and took their course with well defined boundaries downwards to the lower end of the spinal cord, the whole diseased tract having in a greater or less degree all the degenerative characteristics of the central and initiatory morbid change. In the most of cases recorded, this morbid change—if in the brain—would spread from the brain lesion downwards through the crus cerebri, the pons and the anterior pyramid of the same side, then through the posterior section of one of the lateral columns. This corresponds to the anatomical continuity of fibres, as well as to the nutritive track. We often see this trail of disease with the naked eye, in cases of *post mortem*, or those having had hemiplegia, sclerosis, or such like nerve disease. Charcot asserts, that the direction of disease in the posterior columns of the cord is upwards, and of course

never downwards. If that be so, then it is evident degeneration takes the direction of the functional activity of nerve fibres. These grand facts, springing from the study of a nerve cicatrix to a nerve—then from a nerve to the spinal cord—then from the cord to the medulla oblongata and white brain substance, have given us an insight into conditions the microscope could not divulge alone. These morbid changes show, on the one hand, the close intimacy of all nerve fibres; and on the other, the radical distinction of nerve tracts. Nerve fibres seem to lie along side of one another like insulated electric wires, yet quite distinct from one another in function, until some point of *consensus* is reached in a nerve center.

It will be seen then that a good deal of attention has been given lately to the connection nerve influence has upon nutrition. It is asserted that certain parts of nerve centers have more peculiarly the functions of ennervating actions, which convey distinctive energies to focal points of assimilation. It is evident from recent examination that there exist these so-called "trophic centers." These spots of peculiar nerve movement and influence are rich with the multipolar ganglionic cells. Our anatomical knowledge teaches us that these regions thus endowed are in the fourth layer of the cerebral cortex, in the anterior cornea and in the posterior columns of the spinal cord. Prolongations from these minute cells also affect nutrition. This great fact is strikingly illustrated in irritation of the fifth nerve. It is followed by skin eruption, ulceration of the cornea and inflammation of the eye. In paraplegia with wasting of muscles, we find its cause where the multipolar cells most abound in the anterior cornea of the spinal cord. Progressive muscular atrophy has the same record, and an analogous condition exists in

posterior spinal sclerosis. We know how these states consequent on impaired nutrition bring about abnormal conditions of the joints—such as fractures consequent on want of appropriation of animal matter to give the bones elasticity, and even dislocations from want of tone in the surrounding tissues of the joints. Those who have charge of the insane need not be told how the least pressure or blow will produce ecchymosis, and a slight force will be followed by fracture of bone, in some brain diseases. Metastasis of so many ailments is no doubt due to changes following mal-nutrition and the cause of these degenerations is in depreciated nerve supply from these great centers of influence. The initiatory diseased impulses are given from these centers, but must however be always distinguished from those produced by abnormal conditions at the periphery of the nerve apparatus, and followed by vascular changes consequent thereon. Such as the latter are brought about by vaso-motor irritation, and differ materially from the conditions of the "trophic centers" as causes of disease from diminished nutrition. For example, such a disease as Addison's is only a result of trophic disorder of the sympathetic and ganglionic centers. The nervous condition always antedates the pathological changes in the supra-renal capsules. In other words, the difference lies in centric and eccentric causes. I am not sure but glycosuria may be primarily a disease of trophic origin. We know how often it is accompanied with such diseases as phthisis, pneumonia, ulceration of the bowels and suppurative kidneys. The diabetic coma, which is so sudden in its invasion, can not be accounted for from the local disease. The acetonæmia indicates either chemical changes in the blood or organic influence in the liver, but in both cases the active agent is nerve stimulation.

It is not clearly decided where the trophic centers are situated, but it is evident in all forms of nutritive degeneration, that destructive changes take place in the multipolar cells, and often the axis cylinder is changed into merely shrunken tissue. This cell change and obliteration are more particularly seen in the front layer of the brain cortex and in the anterior cornua of the cord. There are yet undiscovered trophic localities in the nerve masses, as there is no evidence that either the motor or sensory nerves have the functions of trophic stimulation. This misdirected force brings about malnutrition in many forms. Atheromatous and calcareous degenerations, general as well as local, give undoubted evidence of its malign influence. We know how emotional shock, worry, or mental depression effect the functions of organic life, in such organs as the stomach, kidneys and the heart. These derangements are brought about through nerve influence, it being the principal factor in inducing depraved nutrition. Many of our hydra-headed forms of dyspepsia are primarily caused by nerve derangement. We now know that the morbid processes of Bright's disease are due to structural changes in the abdominal ganglia of the sympathetic. In other words, albuminuria is in its origin, a ganglionic disease (Da Costa). The writer is convinced that many diseases, whose causes have been attributed to specific germs or organisms, will be found to have their pathological initiatory impulses excited by ganglionic disease.

A number of experiments on head thermometry have recently been made with different results. It is conceded that a difference of about five degrees exists between the heat of the head and that of the axilla, the former being the lower. Of the different parts of the head, the occipital region registers the lowest

Tumors on the brain have uniformly given a high temperature over the region of their existence. Where brain abscesses are formed the result is a temperature of several degrees below the normal, in the same region; the same is also true from embolism of cerebral vessels, followed by hemiplegia. This may be accounted for by the fact that tumors increase the blood supply in the part, but abscess or embolic conditions decrease it. In all, the heat is not normal, and more circumscribed in tumors than in the other two classes of diseases. If these clinical observations can be corroborated by a sufficiently large number of cases to enable us to formulate a positive rule, there is a great step taken in differentiated diagnosis. It is not to be forgotten that thrombosis and abscess often co-exist, and that the former precedes the latter in the order of sequence, and also that congestions, of a temporary kind, of the coverings of the brain, will produce, for a time, an exaltation of temperature. The history of a case in respect to duration, extra-cranial symptoms, or non-local thermal conditions may go far to enable an acute observer to draw lines of distinction in a majority of cases. A rich field of research, based upon blood circulation, and consequently upon local heat, in relation to intra-cranial disease is opening up to investigators. At the same time we are not to be led away to believe too much in this direction, from the pretensions set up in ambitious text-books on nervous diseases. Dr. H. Howard, of Montreal, in a somewhat dogmatic book on insanity, recently published by him, endeavors to show that we find a valuable diagnostic sign of insanity in a low condition of bodily heat, which is, he says, uniformly found. This is true in respect to many cases of melancholy and dementia, but it has no value as a general symptom of insanity in all its

phases. Here, in passing, let me say, that after a number of years of close observation of the heat of the body, and the quality of the pulse in respect to diagnosis of diseases, especially insanity, I have been convinced of the unreliability of these two tests, if depended on alone. When we take into consideration the difficulty of finding the same heat twice, under apparently the same pathological conditions, in the same patient; also that scarcely any two thermometers indicate the same degree under exactly similar influences of heat or cold, it is evident that as a diagnostic method it needs to support it collateral confirmation from other quarters. This is more evident when we consider that alarming conclusions are drawn from only a few degrees above or below the normal standard. If a number of thermometers are put in contact with the same axilla, or under the same tongue, it will be seen how fickle they are, and that even if adjusted, no two of them exactly agree, as at present constructed. They can only approximate to the true condition. This untrustworthiness is true of both temperature and pulse. A sudden bodily movement, a passing emotion, a transitory excitement, a sudden congestion of any of the organs of automatic life, or a shock of depression, may heighten or lower both without any apparent pathological change. To put the matter fairly to the test in insanity, I selected a number of cases belonging to distinct classes of disease, and took the temperature and pulse regularly, morning and evening, for several months at a time. No conclusions of a satisfactory character could be drawn from our trial. To speak generally, in dementia we found the heat and pulse below the standard of health, but in an erratic way, for several days at a time, they would take a leap upwards. In cases where dementia and consumption

were combined, both as a rule were found above normal, but in this condition they were not continuous nor uniform. The nearest approach to stability was found in paresis and consumption combined. In this dual state both pulse and temperature were generally above normal. In paresis alone the same uncertainty prevailed—they rose and fell without any regularity, but oftener above than below the standard. The same was found true of mania and melancholia, even when cold and blue extremities indicated a languid circulation. Neither of them nor both combined showed positive indications of the *genus* or *species* of insanity.

In this connection it may not be out of place to say that little has been done in the way of diagnosis based on the condition of the optic disc and its surroundings. The writer has seen, with the ophthalmoscope, so many normal conditions among the insane, and so many abnormal among the sane, that his faith in reaching diagnosis of brain troubles by this avenue, has been very much shaken. It is true, it has been very well established, that in traumatic lesion of the brain, we often find papillary stasis and hyperæmia of the retina, and this without affecting vision; but on the other hand sight is often impaired without any vascular disturbance, hence, no certain pathological condition of the retina has been found upon which we can attach any diagnostic value. Cerebral stasis—an undue increase of fluid surrounding the brain and the optic sheath, might produce, by compression, a decrease of arterial circulation, or an engorgement of the veins in the optic region, or both, yet, this condition being only temporary, it can give no indications of any permanent brain trouble. The distance between the optic disc and brain proper, with the possibility of a diseased condition existing only in the course of the optic nerve, or

in its envelops, after its emersion from the cerebral mass, will always leave in doubt the diagnostic value of any condition of the eye in its retinal expansion.

Hyperæmia of the optic nerve, redness, swelling, or choking of disc may exist, but they give no indication of brain condition, for they may be purely local. Each individual has a retina distinct in some particulars from any or every other, so no common standard of appearances can be given. We often see a state of vascularity in the retinal vessels, which looks like a congested or inflamed state, yet, it may be normal. We may find a pale, flaccid condition, which we might hastily attribute to disease, but it might only be consequent on languid circulation from cardiac deficiency or an anæmic condition, and yet not be a disease. It is true of this state, that if continued it may end in atrophy from impaired nutrition. At the same time, it is never to be forgotten, that the body is continually an organism of reflex movements and influences, and such being the case, optic abnormalities often produce cerebral disturbance conducive to mental trouble. A small eccentric or distal cause may excite grave complications in the brain, especially if it should be ripe by predisposition to manifest the insane diathesis.

Nothing is more harmless and inert than gunpowder, if not ignited, but the explosive power is only latent, and a lighted match may be the occasion of its potency becoming manifest, so local disease of apparently small importance may in an analogous way be the occasion of exciting causes into manifest energy never dreamed of, until favorable conditions presented themselves. The statement of M. C. Dutuque, that in general paralysis we *always* find irregularity of pupils, papillary congestion, varicose dilation of the arteries and veins of the

retina, obscured disc and optic atrophy, is a sweeping generalization not warranted in a majority of cases of paresis. (*L' Encéphale*, January, 1883).

During the year a large number of cases have been collected to prove the doctrine of cross irritation and movement, as between the motor centers and opposite layers of the body. Many experiments and diseased conditions no doubt prove this fact. At the same time, it is evident an intimate co-relation exists between the encephalon in its hemispheres and both sides of the body. Diseased action in one-half of the brain often produces impaired function simultaneously in both sides of the body, and often on the same side only as that of the affected hemisphere instead of the opposite side, as asserted by some investigators. General want of co-ordination and loss of function is almost uniformly true if the base organs are affected. In nine cases out of ten this is true, if such important organs as the pons varolii, medulla, anterior pyramids and cerebral peduncles are affected. It is true, a large number of cases are recorded in which cross symptoms only follow, but these are nearly all confined to results following the superficial condition of the brain. The whole matter is so far in an unsettled state, but is being closely investigated as opportunities present themselves.

It is now generally conceded that tendon—or rather muscular—reflexes are not always co-existent with Duchenne's disease. At one time, and up to a recent date, it was classed as absolutely pathognomonic of locomotor ataxia, but recent researches show that in a large number of cases this sign is absent. It seems evident the absence is due to the condition of the spinal seat of nerve supply (Prevost and Tschirew).

This location is that section of cord which supplies the three and four lumbar pairs. The presence or

absence of this condition is no doubt largely due to the extent of nerve decay. In a medico-legal sense it is important to know with certainty that the absence of these reflexes are not negative proofs of non-existence of locomotor ataxia. We are often asked in cases affecting the mental condition of a testator to diagnose this spinal disease—pure and simple—from the shuffling gait and prehensile unsteadiness of a case of paresis. The fulcrum point is, to describe a disease and its signs with initiatory mental alienation from one which, as a rule, terminates without brain disease and psychical dethronement, or, if so, only at the termination of its course. At any rate, the tendon reflex must be ruled out as having absolutely no diagnostic value in determining this disease from others of a kindred nature.

In this connection it may not be out of place to state that much diagnostic value may be found in Zoochemistry. In locomotor ataxia, for example, amyloid degeneration in the diseased portions of the cord is very characteristic. It has been held by many pathologists to be either colloid or albuminous; this is not always correct, for the well-known chemical reaction of iodine and starch takes place, with the addition of dilute sulphuric acid; and in addition, the microscope clearly shows bluish starch granules. These starch-like bodies are easily seen in many brain affections, and often in paresis. The condition is evidently a retrograde metamorphosis of the nerve cells. When we think of our chemistry, and remember the definite changes in the alcoholic series of bodies from starch to sugar, alcohol, acetic acid and finally into carbonic acid and water, we know that all only contain three elements with different groupings and greater oxydation, and thus complexity of the analogous bodies increases.

Cerebrin is a nerve substance containing these radical elements, combined with nitrogen and phosphorus. In a degenerative and descending scale, deoxydation would bring about a more primitive grouping of this and analogous substances, and as a result a starch-like body would be generated; in other words, it might be a sugar product. The deoxydation may be caused from deprivation of properly oxygenated blood in nerve tissue, or from an undue formation of deleterious acids in wasting tissues, or from a deficiency of nerve pabulum, or all combined. There is no doubt but the amyloid condition is more frequent than is generally supposed, and is often mistaken for fat granules, or albuminous products. Fatty degeneration may be a disease peculiar to itself, or it may be simply a change of the carbon hydrates into that form, or a sort of secondary degenerative process. A *cerebraic* sugar is thus generated, which gives a starch reaction by loss of the proper equivalents of water. This want of the normal hydrate oxide is doubtless one cause of shrinkage of brain tissue. It is atrophy from a drying up process.

The importance of further investigation, through the aid of chemistry, need scarcely be stated, but differentiated chemical tests of pathological products is one of the possibilities of the future.

Five years ago, at Washington, the writer of this monograph read a paper before this Association, "On the Animal Molecule," and also one before the "Canada Medical Association," at Ottawa, "On Brain Lesions," in which he endeavored to show that the upper parts of the cerebrum were only depositories of vital and psychic power, but the central and basal ganglia were the centers of functional power, and the directors of brain force. Evidence was produced from cerebral structure,

blood supply and pathological conditions to establish this fact, and to account for so little functional and mental disturbance in numberless cases of cortical lesions, and even in their destruction. This view is beginning to attract attention among those better qualified to prove its worth, than the writer can possibly be, because of his comparative want of opportunity.

Couty says, in the light of recent experiments, "The effects of cortical lesions as irritations are always indirect and due to intermediated disorders of the apparatus, comprised between the brain and the peripheral organs—to wit—the bulb and the medulla vertebralis. Disorders of co-ordinations of various forms, can be explained only by supposing a pathological modification of the apparatus of the medulla to which they belong. He concludes that there is no necessary relation between the *nature* and *seat* of a lesion, and the resulting *nature* and *seat* of the motor disorders.

Dr. M. Couty gives us the result of seventy-six experiments made on brains of dogs and monkeys, in the laboratory of the museum of Rio Janeiro, and as a result of these trials he holds that it is not necessary to discard the old views, as to the excitability of grey substance. It has never yet been invariably demonstrated that there is a constant and invariable relation between the seat of lesion and the character of the trouble produced. The lesion of the brain produces remote disturbances whose character depends on the *extent* and in no respect on the *location* of the lesion, by acting by inhibition or exaltation upon remote parts of the nervous system (*Revue Scientifique*).

Golz's experiments have all been in favor of central focal points of energy. They are interesting from a pathological point of view. He not only watched the

immediate effects of destruction of brain substance, but was also able to keep alive the animals operated upon for as long as eight months in severe cases, after the lesion occurred. In this way he could watch secondary effects. The latter condition was more analogous to spontaneous disease in its insidious invasion, than could be the shock of traumatic lesion.

Dr. Exner, of Vienna, has collected one hundred and sixty-eight cases of simple lesion of the cortex cerebri, in which were good histories of the patients and of the *post mortems*. He divided the cerebral surface into three hundred and eighty arbitrary squares, and then compared the functional disturbance with the parts diseased. It is evident such divisions could not be satisfactory unless each square represented a distinct organ, so his conclusions must be reservably received with due allowance for his ingenious device. He found, however, that the cortex had different degrees of excitability, and that small lesions were not to be depended on in studying functions arising therefrom.

Luys, in his recent work on "The Brain and its Functions," holds to a localization theory somewhat different from Charcot, Richet, Ferrier and their school of thinkers. He has proved satisfactorily to himself, that the psycho-intellectual activities are in the cerebral cortex and that the central ganglia focalize these, in being the points for the reception of sensory impressions on the one hand, and of outgoing impulses whether physical or mental on the other. The optic thalamus is the terminal center for sensation, and the corpus striatum is a corresponding center from which radiates voluntary motor excitations. He claims to be the discoverer of this fact, and founds it principally on the morphological analogies found in the structure and

relation of the varied cells existing in the sensory and motor parts of the spinal cord, in connection with their functions in health, and their abnormalites in disease. He asserts physiology and pathology prove that there is a natural bond of union between the cortical substance and these bodies. The one section is associated topographically and functionaliy with the other as co-operant factors, *i. e.*, the peripheral sensory surfaces have receptive organs adapted to them in the central ganglia. These central regions he terms "points of condensation" and "fields of transformation." Impressions are here in some way *intellectualized* and become exciting material in a sort of reflex way for the activity of the cells of the cortical substance and are the only means of communication by which the regions of psychical activity come into indirect or mediate contact with the external world. Luys is, however, not the first who promulgated this theory. Many years ago, Dr. Noble, of Manchester, England, in his work "On the Human Mind in its Relation with the Brain and Nervous System," stated in substance that brain excitations, which are in relation to affections, emotions and desires are controlled by means of the instrumentality of the basal ganglia acting in obedience to the cortical substance. This is, as it were, a germ idea based on the like investigations as those of Luys. Dr. Crichton Browne, some years ago, gave pathological cases to show that the optic thalamus is a high reflex center. Dr. James Ross, in his recent voluminous work "On the Diseases of the Nervous System," is inclined to accept these views of localization, and holds to a central controlling power, but places all psychical phenomena in the cortex of the brain.

The controversy is now going on, and is largely based on the lines of experiment, but the conclusions

are, so far, very diverse and partially unsatisfactory. The last few years have been prolific in pathological research and discovery. The earnest and keen-sighted workers, who are seeking eagerly after truth in this direction, may differ as to their interpretations of function, but they are a unit as to the all-importance of physiological and pathological investigation, in the hope of finding out the reason why of physical and mental modes of life.

Of course, our pathological researches in a dead brain and spinal cord may be interesting, but unless our knowledge thus obtained can lead us to improved therapeutics and rational diagnosis in the living, then is our work that of an antiquary seeking among ruins to know of the glories which have been, but unable to preserve those structures threatened with disintegration and decay.