EXPERIMENTAL RESEARCHES ON THE LOCALIZATION OF THE SYMPATHETIC NERVE IN THE SPINAL CORD AND BRAIN, AND CONTRIBUTIONS TO ITS PHYSIOLOGY.[1]

(ABSTRACT.)

By B. ONUF (ONUFROWICZ), M. D.,

Associate in Pathology, Pathological Institute of the New York State Hospitals; Lecturer on Nervous and Mental Diseases in the New York Polyclinic.

AND

JOSEPH COLLINS, M. D.,

Professor of Diseases of the Mind and Nervous System in the New York Post-Graduate Medical School; Visiting Physician to the City Hospital; Neurologist to the Post-Graduate Hospital, St. Mark's Hospital, and to the St. John's Guild Hospital.

The anatomy and physiology of the nervous system have long been favorite subjects for the study and speculation of scientists. In latter years the method of metal impregnation, inaugurated by Golgi, and the methylene blue method, first successfully utilized by Ehrlich, have lent themselves to the study of this obscure part of the body, and many investigators, of whom we may mention Kölliker, His, Ramon y Cajal, Van Gehuchten, Retzius, Dogiel and Sala, have illumined our knowledge of the minute structure and of the architecture of a large part of the nervous system. Thus far, however, few authors have undertaken to determine the manner in which the sympathetic is connected with, or, better said, localized in, the spinal cord and brain. Of these few, some have speculated from clinical data alone regarding such localization. According to Mott, for instance, Ross was the first to suggest that in tabes the visceral crises and other disturbances of a similar nature are due to affection of the

[1] Read before the American Neurological Association, May 27th, 1898. From the Pathological Institute of the New York State Hospitals.

cells of Clarke's columns. Sachs says "it is not a great stretch of imagination to suppose that tactile sensation and the sensory impulses by which reflex action is excited pass through the lateral series of fibres, whereas those fibres connecting with the columns of Clarke in all probability have to do with the functions of coördination and with the transmission of visceral sensations." The merit of the first attempt to study in a systematic manner the distribution of the "visceral" nerves in the brain and spinal cord is due decidedly to Gaskell. To enter into the details of the highly ingenious plan on which his researches were conducted would lead too far. We can only hint at some of the principal points. Gaskell had demonstrated that in the nerve roots of the cerebrospinal nerves certain medullated fibres distinguish themselves by the fineness of their calibre. He had shown in a convincing manner that these fine fibres represented the visceral fibres of the roots. Furthermore, he had demonstrated the presence of these fine medullated fibres in many of the rami communicantes. By following the course of these fine fibres in the spinal cord he came to definite conclusions, the most important of which are: (1) That the visceral nerves become connected in the spinal cord with the large cells of the lateral horn, which he considers to be a nucleus for efferent fibres to striated splanchnic muscles; (2) that the cells of Clarke's columns give origin to inhibitory fibres for the splanchnic glandular system and the muscles of the viscera and vascular system; (3) that the solitary cells of the posterior horns furnish a motor supply for the muscles of the viscera, and finally (4) that the small cells of the lateral horn form a nucleus of katabolic (motor) nerves to the splanchnic glandular system and to the muscles of the vascular system.

There can be no doubt that some of the premises on which Gaskell bases his conclusions are, in part at least, erroneous. It is an erroneous statement, for instance, that the vasoconstrictor nerves arise only in the thoracic region of the spinal cord. Yet we shall see that, in the main, Gaskell has hit very near to the mark in most of his final conclusions, and we can only praise his ingenious researches, and recommend them for close study to him who wishes information of the structure and central distribution of the sympathetic nervous system.

Mott contends against Gaskell's view that the axis cylinder processes of the cells of Clarke's columns become fibres of the anterior roots, claiming justly that these axis cylinders are continued as fibres of the direct cerebellar tract. Mott considers the nuclei of the funiculi cuneati and Deiters' nucleus to be the homologue of Clarke's column in the medulla oblongata. Blumenau had previously reached the conclusion that the large cells in the lateral portions of the funiculus gracilis and (chiefly) funiculus cuneatus were the homologues of Clarke's columns. Mott's further views regarding the connections of the sympathetic nervous system with the cerebrospinal axis may be summed up as follows:

"The fine, centrifugal, splanchnic fibres which Gaskell found in the anterior roots originate from the bipolar cells of the tractus intermedio-lateralis (lateral horn) and from the solitary cells of the posterior horn. The vago-glosso-pharyngeal nucleus (the one situated beneath the floor of the 4th ventricle) is to be considered as the continuation of the tractus intermedio-lateralis, having the same physiological significance in the medulla oblongata as the latter has in the cord. Other larger cells of the tractus intermedio-lateralis have altogether other functions, and are, perhaps, related to the antero-lateral tract."

Biedl cut the splanchnic nerves in dogs and studied the ascending degeneration in the spinal cord. His conclusions are formulated in a rather vague manner, so that it is difficult to gather where he conceives the location of the centres of the efferent fibres to be, and where he believes the afferent fibres to end in the spinal cord. Yet it would seem that he found a splanchnic motor centre in the lateral horn of the lower cervical and upper dorsal regions. We must not forget to add, however, that the purpose of Biedl's researches was not so much to establish the localization of the splanchnic nerve in the spinal cord as it was to study the histological *character* of the spinal cell changes occurring after section of the nerves mentioned.

Aside from the investigations just discussed (Gaskell's, Mott's and Biedl's), we have found no literature relating to the localization of the sympathetic or visceral nerves in the spinal cord or brain.

In view of the fact, then, that so few investigators have attacked this subject, and particularly that the conclusions of these are disharmonious, it seemed to us justifiable to retake a new experimental and critical survey of the subject.

Notwithstanding the liability to erroneous conclusions by homologizing results obtained from experimentation on animals, we decided to adopt the experimental method for our investigations. It was originally intended to confine our researches to the allocation of the sympathetic nerves in the spinal cord and brain, but some of the physiological observations which the experiments permitted us to make proved interesting enough to be embodied in the report of our findings. In this connection it is necessary to state that the results of our investigations are embodied in a monograph on the sympathetic nervous system, which will soon be published in the Archives of Neurology and Psychopathology. Here we shall attempt to give only a brief abstract of our conclusions, and to illustrate our principal findings by diagrams and drawings.

Our mode of procedure consisted in extirpating various parts of the nervous system, and studying the consecutive ascending degeneration in the spinal cord and oblongata. In all, eight cats were thus successively operated upon. The following operations were performed:

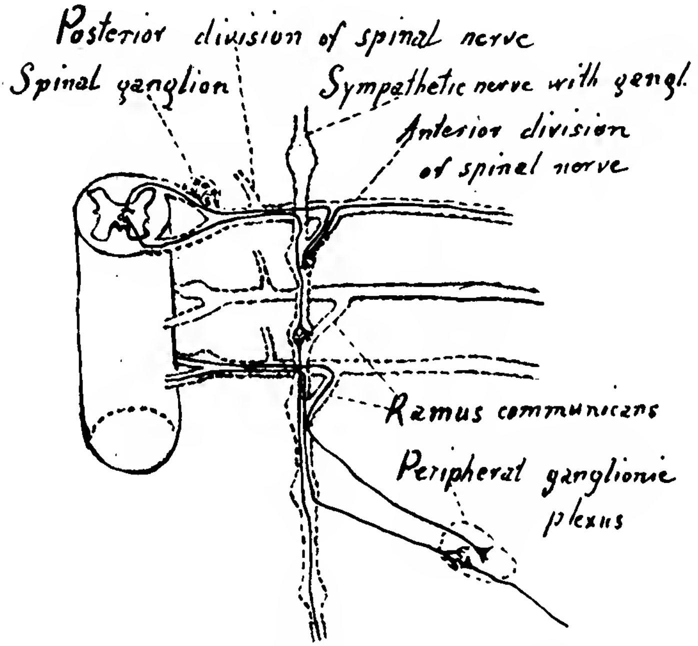
1. Extirpation of the stellate ganglion; a ganglion that corresponds to the cervical and the first thoracic

sympathetic ganglion of man fused into one common ganglion. This operation was done in three young cats.

2. Extirpation of a piece of the thoracic sympathetic nerve with three ganglia in two young cats.

3. Extirpation of the lumbar sympathetic nerve with three ganglia in one young cat.

FIG. I.



4. In two young cats the semilunar ganglion, which is known as the abdominal brain, was extirpated.

Although it is difficult to encompass in a few paragraphs the results of our experiments and observations, we shall endeavor to state the more important conclusions. These can be classified into: First, localizatory; second, physiological; third, general physiological remarks.

I. Localizatory: Our conclusions concerning localization may be summed up as follows:

Most of the afferent (sensory) fibres of the sympathetic nerves do not originate from cells of the spinal ganglia, as

Kölliker claims; on the contrary, they must have, in accordance with Dogiel's view, their cells of origin within the ganglia or plexuses of the sympathetic system.

We believe that the *efferent* fibres of the sympathetic take their origin from the cells of the following groups: First, the paracentral group; second, the small cells of the lateral horn, and third, probably also the small cells of the intermediate zone. By way of explanation, we may say that we have designated as paracentral group that collection of cells situated to both sides of the central canal, directly ventrad of Clarke's column, and sometimes confluent with the latter, especially in very young animals. By intermediate zone we understand an area lying between the bases of the posterior and anterior horns.

The *afferent* fibres of the sympathetic are connected by their terminal arborizations with the cells of Clarke's column, and it seems quite probable that the large cells of the intermediate zone, especially of Bechterew's nucleus, bear the same relation to the visceral afferent fibres as the cells of the vesicular column. We concede that the whole zone separating the anterior from the posterior horns has relations to the fibres of the sympathetic, but we do not thereby imply that many of the cells therein have not altogether different functions.

We saw vertical fibre bundles emerge from Clarke's columns, and bend off in horizontal (dorso-ventral) direction; part of them seemed to lose themselves in what we call the paracentral field. These fibres we have much reason to consider either as direct afferent fibres of the posterior roots or as collaterals. In our monograph we give detailed arguments in favor of the view that they terminate around the small cells of the paracentral group (perhaps also of the intermediate zone), and are thus destined for the enactment of spinal reflexes in the domain of the vegetative nervous system.

In young animals (cats) Clarke's column and the paracentral cell group coalesce almost into one group. Probably in the adult the separation is also incomplete, so that the two may have partially common functions in such manner that part of the cells of Clarke's column (the larger ones) are concerned in afferent, the other (the smaller ones) in efferent functions. Similarly, the large sporadic cells that one meets in the paracentral group may have afferent, while the smaller ones, which form the chief contingent of the group have efferent functions.

Two weeks after extirpation of the 3d, 4th and 5th lumbar sympathetic ganglia we observed degenerative changes, both in the cells of Clarke's columns and in the fibres passing into them from the posterior roots. The degeneration in the fibres reaches from the 3d lumbar up to the 13th dorsal segment; on the other hand, the inferior (caudal) limit of the cell changes must be looked for in the 1st lumbar segment, showing that the cell changes occupy, on the whole, a higher level than the fibre changes, that, accordingly, the afferent fibres of the lumbar sympathetic nerves, entering the spinal cord by way of the posterior roots, make, after having arrived at Clarke's columns, a longitudinal course cephalad to terminate around cells of a considerably higher level.

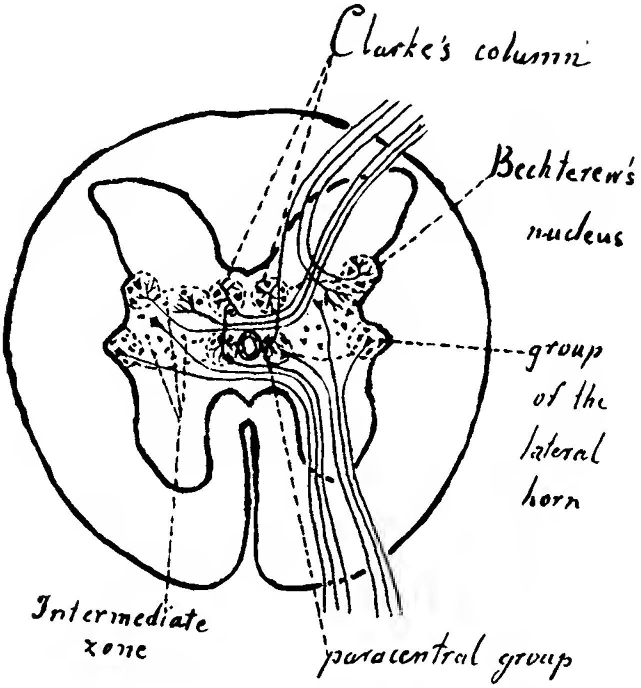
From the distribution of the secondary atrophies observed in the spinal cord four weeks, and six months after extirpation in one case of the 7th (or 6th) to 9th, in the other of the 7th to 11th, thoracic sympathetic ganglia in young cats, we conclude that, on the whole, the fibres—at least the afferent, probably also the efferent—coming from the ganglia of the lower half of the thoracic sympathetic cord, take a rather horizontal course in the spinal cord, becoming connected with spinal cells of the same level, but that part of these fibres descend through the distance of one or more segments before reaching the cells around which they terminate (or from which they originate if they be efferent fibres).

Extirpation of the stellate ganglion causes within a few months retrogressive changes of an atrophic order in the cells of both lateral horns, of both paracentral groups and of both columns of Clarke. These changes extend downward at least to the 9th dorsal segment, showing that many of the afferent and also of the efferent fibres from the stellate ganglion make a long descent in the cord, or possibly in the sympathetic nerve, becoming connected partly with the same cells with which the fibres from the lower portion of the sympathetic cord form connections. We may conclude that the afferent fibres of the sympathetic system, after T-shaped division, become ascending and descending, and thus become connected with several levels of Clarke's columns simultaneously.

Regarding the function of the paracentral group, we have adduced arguments in favor of the view that it may be concerned in vascular and in visceral motor innervation. Clarke's column, besides being a terminal station for afferent fibres conveying impulses from the vegetative organs, may be instrumental also in conducting sensory stimuli from the muscles, tendons, joints and bones to the cerebellum, being thus largely concerned in functions of equilibrium. Stilling's sacral nucleus, situated in the 3d sacral segment, is possibly a coalesced Clarke's column and paracentral group.

Regarding the representation of the sympathetic in the oblongata, we find that it has not yet been proven that the vago-glosso-pharyngeal nucleus situated beneath the floor of the fourth ventricle is a terminal nucleus of purely sensory or afferent function. We are much inclined to share Forel's and Gaskell's view that the nucleus is, on the contrary, predominantly motor in such sense that the axis cylinders of its cells become efferent fibres of the IX. and X., probably also partly of the XI. nerve. The fact, however, that by extirpation of the stellate ganglion—aside from afferent fibres—*only visceral* (vegetative) *efferent* fibres and *no somatic motor* fibres of the vagus nerve (which give off a strong communicating branch to the ganglion), become interrupted, in connection with the observation that as a secondary consequence of such lesion the spinal division of the vago-glosso-pharyngeal nucleus undergoes some, although very slight, atrophy, while the nucleus ambiguus remains normal, leads us to conceive furthermore that the vago-glosso-pharyngeal nucleus gives origin only to visceral (vegetative) efferent

FIG. II.



fibres of the vago-glosso-pharyngeal, and in part also the accessory nerve, and that the nucleus ambiguus gives origin only to somatic efferent fibres of these nerves, that is, to motor fibres supplying striated muscles. In other words, in relation to the so-called lateral mixed system of nerves (which includes the IX., X. and XI. nerves) the so-called vago-glosso-pharyngeal nucleus is probably the visceral (vegetative), the nucleus ambiguus, the somatic nucleus.

The so-called vago-glosso-pharyngeal nucleus is, furthermore, probably the homologue of the paracentral group. The homologue of Clarke's column we believe to be a nucleus accompanying the solitary bundle at its ventro-lateral border. The relation of the afferent fibres of the lateral mixed system (IX., X. and partly XI. nerves) to the two nuclei just mentioned is probably such as we have tried to demonstrate as existing between the spinal visceral fibres on one side and Clarke's column and the paracentral group on the other.

In accordance with this view, the vagus fibres which have been seen terminating in the vago-glosso-pharyngeal nucleus by Van Gehuchten, Kölliker, His and others are to be considered as afferent reflex fibres or collaterals.

II. Physiological conclusions:

In regard to the influence of the sympathetic upon lachrymal secretion, our results were rather contradictory. Removal of the stellate ganglion in one animal apparently prevented secretion of the lachrymal gland of the operated side when pilocarpine was instilled, while in two other cats, on the contrary, the secretion was more profuse on the operated side. Naturally, the lachrymal secretion was an artificial one caused by a poison, pilocarpine. We conclude, therefore, that the results were so contradictory that further experimentation is necessary before positive conclusions can be drawn.

In reference to the sweat secretion, our experiments seemed to warrant the assertion that not all sweat secretory fibres of the forepaw pass though the stellate ganglion, and through the main trunk of the sympathetic in general, as Luchsinger and Langley assume, but that a good portion of them follow other pathways, and that these fibres develop a compensatory function so strongly as to entirely mask the loss of function. But yet we had to note the paradoxical fact that in a cat in which the stellate ganglion was removed, there was sweating of all the paws except the left forepaw, as the result of the animal's struggles during etherization.

In reference to the influence of the sympathetic system on the pupil, our experiments led us to believe that the cervical sympathetic contains not only pupil-dilating fibres, but very probably pupil-contracting fibres as well.

Regarding digestion, we found that disturbance of that function followed invariably on removal of the stellate ganglion, of the lower thoracic portion of the sympathetic and of a semilunar ganglion. The digestive disturbances that ensue after removal of the stellate ganglion are, however, more marked and more persistent than those noted after removal of the lower thoracic sympathetic. They consisted of diarrhœa and of putrefaction of the fæces. They were more or less remote symptoms, and they showed a progressive tendency.

We observed that removal of one stellate ganglion, as well as defect of the lower part of the thoracic sympathetic (including the splanchnic at this level), gives rise to attacks of sneezing, to paroxysms of coughing and to hiccough. The cough occurs not only spontaneously, but a paroxysm of coughing could always be precipitated by stroking the animal's back, particularly the nuchal portion. Removal of the stellate ganglion causes, in addition, first a mucous, then a purulent discharge from the nasal mucous membrane. In one case it produced a chronic purulent bronchial catarrh with lobular infiltration of the lungs. The attacks of cough and hiccough gave the impression of nervous symptoms due to defective inhibitory action. The respiratory disturbances were more grave in a case of removal of the stellate ganglion than in a case in which resection of the thoracic sympathetic in its lower portion was done. We noted that resection of the lower part of the sympathetic was followed by diabetes, and, considering the large amount of sugar found four months after the operation, we are led to the belief that the glycosuria caused by such lesions is not temporary, but permanent, and seems to have a tendency to increase rather than to diminish.

In reference to the effect of extirpation of the stellate ganglion on the local temperature, we found that there was an immediate and a remote increase of from one to two degrees Fahrenheit.

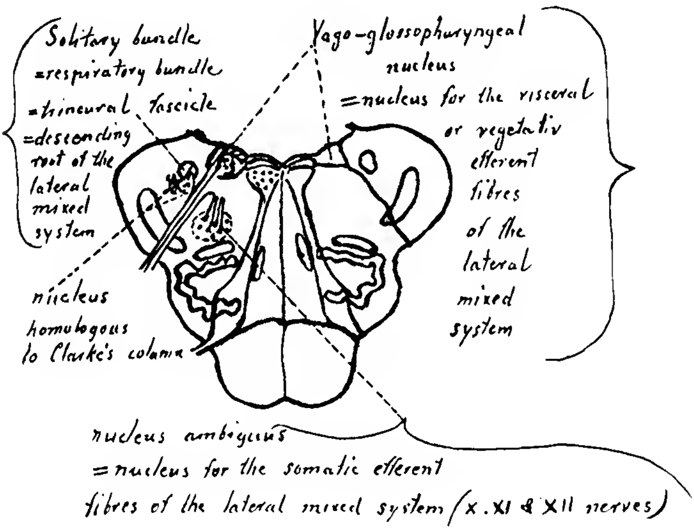
Concerning the pilomotor nerves, we concluded that, although they have, on the whole, the segmental distribution which Langley and Sherrington attribute to them, there must be a collateral supply, or a direct cerebrospinal supply, which can, in the course of time, entirely replace the functional loss which extirpation of three or four successive ganglia causes.

The trophic influences which we observed in connection with lesions of the sympathetic were most evident after removal of the stellate and the lower thoracic ganglia. They were bilateral, although quite irregular in distribution, and were predominantly cutaneous (partial alopecia). It is probable that the nasal, bronchial and laryngeal secretion already spoken of may be on a trophic basis.

III. General Physiological Remarks:

The essential influence which the sympathetic system exercises on the vegetative life of the organism has been amply demonstrated by numerous physiological observations. Inasmuch as some vegetative functions are exquisitely vital, we may say also that the sympathetic system possesses in high degree vital function. This is confirmed by our observations. In very young cats lesions of the important parts of the sympathetic invariably proved fatal. Even if the animals outlived such operations as extirpation of the semilunar ganglion, or removal of the stellate ganglion, or resection of the lower part of the thoracic sympathetic, they invariably died, usually a few hours or days, afterward. One cat of four weeks of age survived the removal of one semilunar ganglion three weeks, being at first quite playful and apparently healthy, but at the end of two weeks he was attacked by diarrhœa, and died in a state of collapse. Even a cat of five and a half weeks, in which we had removed three lumbar ganglia, would have died from collapse two weeks after the operation, had we not preferred to kill it by chloroform, and in this case no tangible cause of the collapse, except the defect of the said three ganglia, could be found.

FIG. III.



We desire to call attention to the fact that the death of many animals during the operations was caused by pulling upon the sympathetic nerve or bruising of a sympathetic ganglion. We noted that this was especially the case in operating to remove the stellate ganglion. Although the animal would be breathing vigorously and fully immediately before, as soon as the stellate ganglion was pulled upon, or as soon as its connection with the thoracic sympathetic nerve was severed, respiration became suddenly arrested, and the animal promptly died.

With older animals, that is, with cats which had reached the age of five or six weeks, we succeeded much better, and three of them lived from three to five months after the operation, when they were killed.

In closing, we wish to call attention to a method of physiological research which may serve to enlighten us on points for which the other methods give us no sufficient information. This method consists in studying, not the immediate, but the remote effects of injuries of certain loci of the nervous system; of investigating not only the perversion or loss of function, which is the immediate result of the removal or section of some ganglion or nerve, but also the compensation of the functional defect that occurs in the course of time. In this manner it is often possible to determine whether certain functions are performed exclusively by a definite nerve or ganglion, or whether other nerves or ganglia share in the fulfillment of this function. Illustrations of the truth of this are given in the observations made by us on the pupils of cats in which a stellate ganglion had been removed. The immediate consequence of this operation was reduction of the size of the pupil of the operated side to one-third, or less, of the size of the other pupil. Gradually, however, the difference in the size of the two pupils diminished, until in the course of from three to five months, it had entirely disappeared, showing in the most convincing way, by this compensation of function, that not all pupil-dilating fibres are derived from the cervical sympathetic nerve and stellate ganglion. The method mentioned has given another interesting result bearing on the same point. When, three months after the removal of one stellate ganglion, the ganglion of the other side was removed, a test of the pupillary reaction showed that the pupil of the side first operated upon contracted much more intensely and more rapidly to light than the other pupil. This fact can hardly be explained otherwise than by granting that the cervical sympathetic contains not only pupil-dilating but also pupil-contracting fibres. Owing to this compensation, the pupil of the side on which the stellate ganglion had been removed three months previously to the test contracted much more promptly than the pupil of the other side, on which the ganglion had been extirpated just before the test.

No less interesting were the results which we obtained regarding the sweat fibres of the forepaw of the cat, and regarding the influence of the cervical sympathetic on lachrymal secretion. Twenty-five days after extirpation of the left stellate ganglion injection of one centigramme of pilocarpine caused no perceptible change in the state of the left forepaw, while when an injection or instillation of pilocarpine was made three or four and a half months after this operation (in two other cats), the forepaw of the operated side sweated quite abundantly, and in one case apparently no less than that of the other side.

Moreover, injection of pilocarpine three weeks after extirpation of the left stellate ganglion caused profound lachrymal secretion on the healthy side, the eye of the operated side remaining dry; while, on the contrary, three months after this operation (in another cat) the eye of the operated side secreted much less than that of the healthy side when pilocarpine was injected. In a third animal, finally, four and a half months after the defect of the ganglion, pilocarpine instillation produced lachrymal secretion of both eyes in an equal degree.

The contrast between the direct and the remote consequences of the defect of certain parts of the sympathetic system is further shown in quite an opposite direction. While such defects seem at first not to cause any disturbance of certain functions, such disturbances often make their appearance weeks, and even months, after the defect is created and show a tendency to progression. No legitimate conclusions could be drawn as to the effect of the removal of the stellate ganglion upon the gastric and intestinal functions during the first four weeks after such removal, because during this period these functions appeared quite normal. Nevertheless, they became markedly disordered later. In the same manner two cats which were deprived of the semilunar ganglion showed no symptoms in the first two weeks after the operation, but at the end of that time one of them was taken with diarrhœa, and finally, three weeks after the operation, it died in a state of collapse. The second cat did not begin to have vomiting attacks until three weeks after the injury had been inflicted.

In like manner the disturbances of respiration observed after removal of the stellate ganglion, or the lower portion of the thoracic sympathetic nerve, differed in their immediate and remote consequences. In one case, for instance, pertussis-like paroxysms set in as late as two months after resection of the thoracic sympathetic nerve with the adjoining piece of the splanchnic.

The clinical importance of these facts needs no mention.

DISCUSSION.

Dr. William G. Spiller said that the paper read by Drs. Onuf and Collins contained so much valuable material, and was of such a character, that in discussing it one could hardly do justice to it after hearing it read once. The importance attached by the authors to the columns of Clarke and the cells in this region seemed to be justified by the investigations of others. Marinesco has advanced the view that Morvan's disease may be due to an affection of the posterior horns and intermediate gray matter, and the speaker said that about two years ago he, in connection with Dr. Dercum, reported a case of syringomyelia with arthropathy of the shoulder joint, in which the lesion in the cervical cord was limited to the posterior horn on the same side as the arthropathy. Dr. Spiller said he was inclined to believe that the cells of the intermediate gray matter, between the anterior and posterior horns, may be concerned with vasomotor and similar functions.

Drs. Onuf and Collins spoke of the presence of pupillary fibres in the sympathetic; the investigations of Madame Dejerine, Oppenheim, and others have fully established the fact that these fibres leave the spinal cord through the upper thoracic roots. The statement made by Onuf and Collins that constricting fibres of the pupil are contained in the sympathetic is of much interest.

Marinesco found the posterior nucleus of the vagus degenerated after lesions of this nerve, and concluded that this posterior nucleus must be motor. Van Gehuchten has sought to explain this degeneration in another way. Dr. Spiller said that Dr. Dercum and he had just reported to the association a case of amyotrophic lateral sclerosis, in which the posterior nucleus of the vagus was degenerated, and the anterior was apparently normal. They had found a number of similar cases in the literature. In this disease the motor system is chiefly affected, and it is remarkable that the posterior nucleus of the vagus should present such evident signs of degeneration if it is a sensory nucleus.

Dr. Onuf, in reply to a question by Dr. Booth, said that in their experiments the thoracic sympathetic had been removed in two cases, and in both instances the animals developed diabetes.

Dr. F. W. Langdon was inclined to believe that the paper of Drs. Onuf and Collins would prove of great clinical importance. In myelitis, for example, we are all acquainted with the variability of the symptoms, and the speaker said that in locating such lesions he had always laid considerable stress upon the presence or absence of trophic symptoms. He had come to look upon the occurrence of marked trophic disturbances, bed-sores and similar conditions, as an indication of a lesion far back in the gray matter, and the investigations of Drs. Onuf and Collins give us a very satisfactory reason for this clinical fact.

Dr. Joseph Collins did not think it necessary to speak further of the experimental conclusions contained in the paper, but added a few remarks on the clinical aspect of the subject. In their experiments they had had in mind that if the sympathetic could be located in the spinal cord, certain symptoms of syringomyelia and tabes, about which we are now in the dark, could be easily explained. Not long ago he saw a boy, 13 years old, whose symptoms were diarrhœa, paroxysmal in character, which had extended over a period of several years; a condition of the right eye commonly known as the "Schultze eye," atrophy of the thenar and hypothenar eminences of the right hand, and cervicodorsal kyphosis. No sensory symptoms were noted. Dr. Collins said he hazarded the diagnosis of syringomyelia, despite the absence of sensory phenomena, and explained the symptoms in this case by the presence of a lesion in the central canal, which, in extending, implicated the paracentral nuclei and the nuclei of the intermediate zone, without encroaching upon any of the sensory fibres. The allocation of the sympathetic to the medulla oblongata, which their results showed, threw much light on the interpretation of symptoms referable to the sympathetic system, occurring with bulbar disease and asthenic bulbar paralysis.

Dr. Onuf, in closing, said that several investigators have shown that all the dilating nerve fibres of the pupil are not derived from the cervical sympathetic; compensatory fibres being derived from the cranial nerves, probably the trigeminal.

He thought that the more we learn about the localization of the sympathetic nerve, the less shall we be inclined to diagnose syringomyelia in a diagrammatic or dogmatic way, and the more shall we be guided by a knowledge of the localization of the lesions. In syringomyelia it is not really the disease that makes the peculiar combination of the symptoms; it is the location of the process.

---

220. Amyotrophic Lateral Sclerosis. Raymond (La Presse Médicale, Nos. 41 and 43, 1897).

After a clinical demonstration of two cases (one male, one female) of this disease, which began with bulbar symptoms, and in which the arms and legs were later affected, the author discusses the relationship existing between amyotrophic lateral sclerosis, glosso-labial-laryngeal paralysis and progressive muscular atrophy of the Aran-Duchenne type. Certain authorities, headed by Leyden, hold that there is no spinal muscular atrophy depending upon a lesion strictly limited to the cells of the anterior horns, but that there is always more or less involvement of the fibres of the pyramidal tracts. Others of the school of Vulpian, of whom Dejerine is the chief representative, deny the existence of a glosso-labio-laryngeal paralysis due to lesion of the bulbar nuclei, without involvement of the pyramidal tracts in that region. Each of these views the author thinks incorrect. He cites an observation by Jean Charcot of a case presenting the typical symptoms of spinal muscular atrophy of the Aran-Duchenne type, in which lesion of the cells of the anterior horns, without involvement of the white columns, was found, and one of his own of a case of glosso-labio-laryngeal paralysis, in which the lesion was strictly limited to the nuclei of the bulb and concluded that while they may be closely related, the diseases in question must be considered as separate and distinct morbid entities. As to the lesion causing the rigidity and spasmodic phenomena in amyotrophic lateral sclerosis, the author expresses the opinion that it is not the sclerosis of the lateral tracts, but is probably a lesion in the gray matter of the cerebrum. As negative evidence, he mentions a case of Senator's, in which, though the clinical picture of amyotrophic lateral sclerosis, with involvement of the bulbar nuclei, was present, the atrophy disclosed degeneration of the bulbar and spinal nuclei, with diffused lesions throughout the cord, but no sclerosis of the lateral tracts. Positive evidence supporting his view he does not give. Allen.