

ART. XXX.—*The Physiology and Pathology of the Sympathetic or Ganglionic Nervous System*. By ROBERT T. EDES, M.D. An Essay to which the O'Reilly Prize was awarded by the New York Academy of Medicine, May 5th, 1869. 8vo., pp. 152. Printed for the Academy. New York: Wm. Wood & Co., 1869.

THIS essay, while it does not pretend to be based on extensive original research, is nevertheless a sufficiently full and just exposition, to the date of publication, of a most difficult subject. Moreover, while it is not too full to be placed as collateral reading in the hands of students, the references are so complete as to make it suitable for the use of the practical worker. We shall endeavour to present, principally from the summaries of the author, the prominent features of the paper.

According to Dr. Edes, the sympathetic system includes the ganglion-bearing cord, situated on the sides of the vertebral column, from the superior cervical ganglion to the ganglion impar; of four ganglia in the head, the ophthalmic, sphenopalatine (Meckel's), otic, and submaxillary; and of various large and small ganglia in the thorax and abdomen, with their connecting cords, besides those vaso-motor nerves accompanying the cerebro-spinal nerves from their origin in the spinal cord, which have not passed through the ganglia. We have ourselves always thought that among the ganglia of the sympathetic should be included those on the posterior roots of the spinal nerves, as well as the ganglia of the pneumogastric and glosso-pharyngeal.

As to the elements of the sympathetic, they are said to be mere fibres, mere cells, and special peripheral terminations. As to *cells*, the views of Kölliker, Pollak, Duchenne, Beale, and Arnold are given with regard to the existence of apolar and unipolar cells in the ganglia, but no particular view is adopted. The majority of these authorities oppose the existence of apolar and unipolar cells, but the existence of bipolar and multipolar cells is abundantly established; so also the spiral-fibred bipolar cells of Beale and Arnold. The nerve *fibres* include the dark-bordered, and the pale non-medullated fibres of Remak, the variable proportion of these giving the different shades of colour presented by different portions of the sympathetic system. That many, if not all the dark-bordered fibres contained in the sympathetic are derived from the cerebro-spinal system cannot be denied, but whether they should strictly be considered a part of the sympathetic is perhaps doubtful. Yet it is more doubtful whether they can ever be anatomically or physiologically separated. Strictly speaking, the sympathetic fibres should be restricted to those originating in the ganglion cells of the sympathetic ganglia. The author states that the assumption by Jacobowitsch of certain cells of the spinal cord as sympathetic is apparently unfounded.

The *terminal arrangements* of the sympathetic are imperfectly determined; the proximate plexus of nucleated fibres upon the smooth muscles to which this system is distributed is, however, generally admitted.

With regard to a capital centre, the author writes thus: "What the primary centre for the sympathetic motor fibres is, or whether there is any distinctly limited centre, separate from the other motor ganglia, is not ascertained. It is undoubtedly above the medulla oblongata. The vaso-motor centre is supposed to be in the crura cerebri, but it certainly is not entirely uninfluenced by lesions higher up than this, as is shown by pathological facts. The fibres pass downwards in the cerebro-spinal axis, probably in the anterior columns,

leaving it through the anterior roots, and even through some cerebral nerves. They then, with the exception of certain fibres which have been before mentioned, and which follow throughout the trunks of the mixed motor and sensitive nerves, join the ganglionated cord, and are thence distributed." If these facts, based upon the observations of Budge, are correct, the vaso-motor centre, for the reasons above given, should, perhaps, in a strict classification, be excluded from the sympathetic, and the bundles of the latter must then be regarded as mere vehicles for those cerebro-spinal nerves which act as vaso-motor nerves. Or else it would seem that all attempts at separate anatomical classification must be laid aside. The truth is that the sympathetic cannot be separated from the cerebro-spinal system, and to this conclusion indeed is the author properly drawn, as appears from the concluding paragraph of his section on the anatomy:—

"The sympathetic is to be regarded, according to the foregoing description, as a cerebro-spinal nerve, containing some fibres peculiar to itself, and distributed to the head and smooth muscular fibres. It differs from the other cerebro-spinal nerves in containing a large number of ganglia, at intervals, from near the beginning to the final distribution. It has a tendency to the formation of plexuses more or less complicated. The direct vaso-motor fibres are an exception to a part of this description, but are closely united to the remainder of the system by their distribution and functions." (p. 13.)

As to the distribution of the sympathetic it is to the smooth muscular fibres except in the case of the heart. We are informed that other exceptions are only apparent.

The physiological relations of the sympathetic to the pupil and smooth muscles, to temperature, circulation, heart, secretions, intestines, and pelvic viscera, we condense from the author's summary, on page 82:—

The sympathetic is distributed to both constrictor and dilator of the pupil, and assists in the movements of the iris. It excites several smooth muscles of the orbit and the skin, furnishes motor nerves to the heart, and controls the circulation in the bloodvessels, not only regulating the supply of blood to different organs, but also maintaining a due degree of contraction of the vessels, and exercising an important influence on the general circulation; the contraction is accomplished by the smooth muscular fibres, and the dilatation by the pressure of the blood. Heat, secretion, and nutrition are evidently influenced by the sympathetic, but the direct influence of this system or the cerebro-spinal on secreting cells is doubtful. It is a motor nerve for the intestines and genito-urinary apparatus; it contains also sensitive nerves, but the sensations usually become reflected motor impulses before they reach the brain. The distribution of the sympathetic takes place almost universally through plexuses containing ganglia, and the peripheral ganglia are able to continue the functions of the nerve independently. It is these ganglia which, under stimulation, act as paralyzants or "brakes," diminishing its action and making the system one of inhibition. It will be recollected that this is a function usually ascribed to the pneumogastric, with which, however, the author's view is not inconsistent, if we admit the ganglion on this nerve to be sympathetic. A similar action sometimes takes place in more central ganglia, when a sensitive nerve becomes inhibitory. The system is a dependence upon the cerebro-spinal, from which it differs more in its distribution than its origin.

Its motor fibres are physiologically stimulated by reflex irritations, either from its own sensitive fibres, or from those of the remainder of the cerebro-spinal system, and by psychical stimuli; the reflection may take place in the ganglia near the distribution; probably also in those nearer the centres, in the spinal cord, or in the encephalon. The exact position of the encephalic

centres is, however, unknown, though they are probably above the medulla oblongata. Several portions of the spinal cord from which motor fibres for special organs arise, and from which stimuli act on these organs with greatest intensity, have been called spinal centres, and have received names corresponding with the organs influenced.

The consideration of the *pathology* of the sympathetic is preceded by the following truthful paragraph:—

"If our list of diseases or affections of the sympathetic system were to include only those proved to be such, it would be a very short one; but if, on the contrary, it were to consist of all that have been supposed to be caused by troubles of this system, it would be very much like a treatise on the theory and practice of medicine."

The principal points in the pathology of the sympathetic are included in the last section, which we subjoin with little abridgment:—

The principal change is found in a hypertrophy of interstitial connective tissue with consequent atrophy of nervous elements.

The nerves of this system may be affected with neuralgia. (Colic, cœliac neuralgia, and, perhaps, angina pectoris.)

The iris often betrays irritation or paralysis of the sympathetic, from pressure by tumours of various kinds. It is also acted upon by lesions of cilio-spinal centres, and by reflex irritations.

It is for these reasons, and not from any essential connection, that progressive locomotor ataxy is sometimes accompanied by symptoms on the part of the pupil.

Many cases occur in which the effects on the temperature of vaso-motor paralysis, depending upon lesions either of nerve trunks, of spinal cord, or of encephalon, coincide with those determined by experiment.

The phenomena of fever are largely dependent on sympathetic disturbance.

The secretions are influenced by the nervous system, principally by the action of vaso-motor nervous fibres on the vessels. Certain motor nerves act apparently as stimulants to secretion, probably by their paralyzing effect on the sympathetic, possibly by a direct action on the secreting cells.

Many affections of nutrition are caused by injuries to nerves. It is probable that the larger part are due to irritation rather than to paralysis. A certain small amount of hypertrophy (as ophthalmic goitre, desquamation of epidermis), and sloughing are the most marked consequences of vaso-motor paralysis.

The grounds for assuming the existence of trophic nerves are very slight.

Several diseases of the skin are connected with nervous disorders probably of vaso-motor nerves (erythema, acne, urticaria, herpes, and, perhaps, pemphigus).

Some functional diseases are due to temporary disturbance of supply of blood, especially to central nervous system (epilepsy and allied affections).

The heart may receive too much or too little acceleratory stimulus from the sympathetic, and the same may be said of the intestines and uterus.

We heartily commend this essay to all students of the sympathetic, as the most comprehensive recent treatise on the subject of which we have knowledge, and regret that the mode of publication seems to permit such a limited circulation.

J. T.