treatment the papules give place to pustules, which likewise are pierced by hairs. The pustules show no tendency to run together and form patches as do those of eczema. After a time the pustules dry up and small crusts from about the hairs. If the disease is very intense infiltrated patches will form, and, instead of pustules, there may be abscesses. New papules continue to form and undergo their evolution into pustules, so that we find both forms of lesions present at the same time. The hairs in the pustules early lose their lustre. While at first firmly seated in their follicles so that attempts at depilation are painful, when the pustules are fully formed the hairs come out easily and without much if any pain. When the hairs are extracted early their root sheaths appear as glassy cylinders. After the pustules form the root sheaths will be yellowish and swollen with pus. While usually the hair is not permanently damaged, in chronic cases the hair papillæ are destroyed, the beard is thinned, and small cicatrices are seen.

The course of the disease is chronic, marked by relapses, the disease being at one time apparently cured, and then breaking out again with renewed violence.

Any part of the bearded portion of the face may be attacked. The disease is specially common on the upper lip. Usually there will be found at the same time a catarrhal or purulent discharge from the nose. The cheeks are the parts next most frequently affected, either one or both. The disease may occur symmetrically. It may be limited to a single area. As a rule it does not occur below the angle of the jaw. If it does occur there it is usually by extension from the cheeks. With it there is no eruption upon the non-hairy parts of the face. Not uncommonly the eyebrows and the eye-lashes are affected at the same time as the cheeks.

There is little if any itching, the patient complaining rather of a feeling of soreness, distention, or burning.

Secondly, as it occurs on other parts. On the eyebrows and pubes and in the axillæ the appearances are similar to what obtains on the face, and the course of the disease is the same. On the scalp we meet with the characteristic papules and pustules pierced by hairs. When the disease occurs on the limbs (and it is mostly on the legs that it occurs), we find the same lesions; but, as the hair is more sparse, there is not the same tendency to form diffuse patches, the lesions remaining discrete throughout.

ETIOLOGY.—There is no doubt that the disease is parasitic. The majority of investigators ascribe its origin to the invasion of the hair follicles by the staphylococcus aureus et albus. Sabouraud states that it is due to the staphylococcus aureus alone. Unna teaches that there are two varieties of the disease, one of which he names the coccogenic, being due to the staphylococcus aureus et albus; and the other bacilligenic, being due to an organism which he calls *bacillus sycosiferus fœtidus*.

The disease is contagious, and barber shops are, without doubt, a frequent source of contagion. Like many other diseases due to micro-organisms, there are two factors at work—one the predisposing cause, the character of the soil; and the other the exciting cause, the micro-organism. Eczema is sometimes the forerunner of sycosis. Other predisposing agencies are irritant applications to the skin, such as mustard or other poultices, intense heat, cosmetics, and the like. A nasal discharge is the predisposing cause of sycosis of the upper lip. Shaving with a dull razor is supposed to be the cause in some cases, but those who do not shave are by no means exempt from the disease. Most patients with sycosis are in poor general condition. Men naturally are the most frequent sufferers from the disease.

PATHOLOGY.—Sycosis is primarily a perifolliculitis, the hair follicle and the sebaceous glands being affected secondarily.

DIAGNOSIS.—The two diseases from which sycosis must especially be differentiated are eczema and ringworm of the beard.

Eczema may be limited to the bearded portion of the face, but it is prone to pass over to the non-hairy parts; sycosis is confined to the hairy parts. Eczema is very pruritic and the skin is scratched; sycosis is not pruritic and the skin is not scratched. The lesions of eczema bear no special relation to the hairs; it is a catarrhal disease of the skin, and the hairs are affected as it were accidentally and superficially. No matter how bad an eczema may be, it never destroys the hair. Sycosis is primarily a disease of the hair, the skin between the individual hairs is unaffected except in very bad cases, and the hair may be destroyed. In eczema crusting is a feature of the disease, and when the crusts are removed a raw and oozing surface is exposed. In sycosis the crusts are usually confined to the hair follicles. If diffused crusts are formed, when they are removed it will be found that the hairs stand in little inflammatory areas while the intervening skin does not present a moist surface as is the case in eczema. In some cases it is impossible to make a diagnosis at first, but it is arrived at by studying the effect of treatment, sycosis being more intractable than eczema, and the follicular character becoming more pronounced as the disease approaches recovery.

Ringworm of the beard usually occurs on the chin and neck below the angle of the jaw; sycosis occurs most often on the upper lip and cheeks. Ringworm occurs either as a superficial scaly ring or as large-sized nodules arranged in circles and segments of circles; sycosis occurs as an eruption of papules and pustules pierced by hairs and without any grouping. In ringworm the hairs are broken and split and can be pulled out readily though the root is often left behind; in sycosis the hairs lose their lustre, but otherwise are unaffected, and in the early stages attempts at removing them are very painful. Ringworm once cured does not tend to relapse; sycosis does. Under the microscope the hairs from a case of ringworm will be found loaded with spores and mycelia; in sycosis micro-organisms are found not in the hair but in cultivations from the follicle contents.

Acne should offer no difficulty in diagnosis, as it occurs all over the face and comedones are always present.

PROGNOSIS.—While the disease is essentially chronic, it is curable. Permanent loss of hair is exceptional.

TREATMENT.—When the upper lip is affected it is necessary first to seek out and cure any disease of the mucous membrane of the nose that may be present. In all cases attention to the general health should be given, so as to improve the character of the soil and enable it to resist the invasion of the fungus. The skin must be protected from irritation. The congestion of the skin that is often present in acute cases should be relieved by the administration of laxatives. There is no specific for the disease. Locally, the treatment will vary with the stage of the disease. At the beginning the inflammation may be treated by bathing the affected parts with hot water and following this with an alkaline lotion, such as black wash, lead and opium wash, or a zinc lotion containing two per cent. of salicylic acid. In some cases the application of six drachms of the ointment of the ammoniate of mercury and two drachms of cold cream will abort the disease. When pustules have formed the hairs should be plucked from the diseased follicles,—a conservative process, as it tends to prevent the destruction of the hair papillæ. If there are a large number of pustules a rapidly favorable effect may be produced by going over the face with a dermal curette, after which the parts should be bathed with a 1 to 1,000 solution of bichloride of mercury. If crusts are present they should be removed by soaking them at night with a two-per-cent. solution of salicylic acid in sweet oil, and washing them off on the next day with soap and water. The applications advised above may be used. Diachylon ointment, made according to Hebra's formula and spread on cloths and bound down on the face, is an excellent remedy.

In more chronic conditions sulphur ointment is often a sovereign remedy. The employment of tumenol is at times followed by brilliant results. Tar ointment may be used. In very obstinate cases we may have to resort to stimulation by means of scrubbing with green soap and then binding on zinc-oxide ointment. It is best to keep the beard clipped short during treatment. Epilation is

advised by many authorities. Many cases have been cured by both radio- and phototherapy. As the disease is a most obstinate one, we shall have to make many changes in our treatment before we succeed in curing it. It is well to continue some protective applications for several weeks after the disease seems to have been cured.

George Thomas Jackson.

SYMPATHETIC NERVOUS SYSTEM.—An orderly presentation of the facts and theories relating to the sympathetic nervous system calls for the adoption of the following three heads: Anatomy, Histology, and Physiology.

GENERAL SURVEY OF ANATOMY.

The sympathetic nervous system is composed of the following anatomical elements:

1. The great gangliated cords. 2. The intermediate or central nerve plexuses. 3. The peripheral plexuses. 4. The terminal or monocellular ganglia. The general structure and topographical relations of each of these will first be considered, and afterward the general relations of these divisions to each other and to the central nervous system.

I. *The Great Gangliated Cords.*—The great gangliated cords (sympathetic cords, sympathetic nerves; trunci sympathici; Grenzstrang des Sympathicus; nerf grand sympathique) consist of a series of ganglia (sympathetic ganglia, ganglia trunci sympathici) united to each other by longitudinal cords, the so-called *rami internodiales.* These two gangliated cords are placed symmetrically, partly in front and partly to the side of the vertebral column, and extend from the base of the skull to the coccyx. The internal carotid nerve which emanates from the uppermost cervical sympathetic ganglion must be considered the upward continuation of the sympathetic cord into the region of the head. Some of the cephalic ganglia, viz., the ciliary, the sphenopalatine, the otic, the submaxillary, likewise the cervical ganglion of the pneumogastric, and probably also the ganglion petrosum glossopharyngei, must be regarded as homologues of the ganglia of the great sympathetic cords.

The two great gangliated cords and their homologues in the cranial division of the sympathetic have the following connections:

1. *The Interfunicular Cords or Rami* (*Rami Interfuniculares*). These serve to unite the two great gangliated cords and are developed to the greatest extent in the lumbar and sacral portions of the sympathetic nerves.

2. *The Communicating Rami* (*Rami Communicantes*) establish a connection between the sympathetic ganglia and the cerebro-spinal nerves. By these rami communicantes the ganglia of the sympathetic chain are united with the anterior primary divisions of the spinal nerves of their immediate vicinity. There are white and gray rami communicantes, the former consisting mainly of medullated fibres, the latter of pale fibres (Gaskell). The two kinds form either separate branches or are in other instances blended into one cord, composed of a white and a gray part. Having arrived in the spinal nerves, the fibres of the rami communicantes, according to Gaskell, take opposite directions; part of the fibres, contained mainly if not all in the white rami, pass into the spinal cord; the other part, contained chiefly, perhaps exclusively, in the gray rami, assume a centrifugal course, passing with the other fibres of the spinal nerve to the periphery. (See Fig. 4576 and page 581.)

The rami communicantes are represented in the cranial division of the sympathetic system by the so-called roots of the cranial sympathetic ganglia (the sphenopalatine, ciliary, etc.).

3. *The Peripheral Rami* (Hoffman and Rauber) or *Rami Efferentes seu Afferentes.* These are branches proceeding from the gangliated cord to the prevertebral plexuses or vice versa.

We now pass to

II. *The Intermediate or Central Nerve Plexuses of the Sympathetic.*—Here it will be convenient to distinguish, as Thane (Quain's "Anatomy") proposes:

1. *The Large Prevertebral Plexuses.* These are three

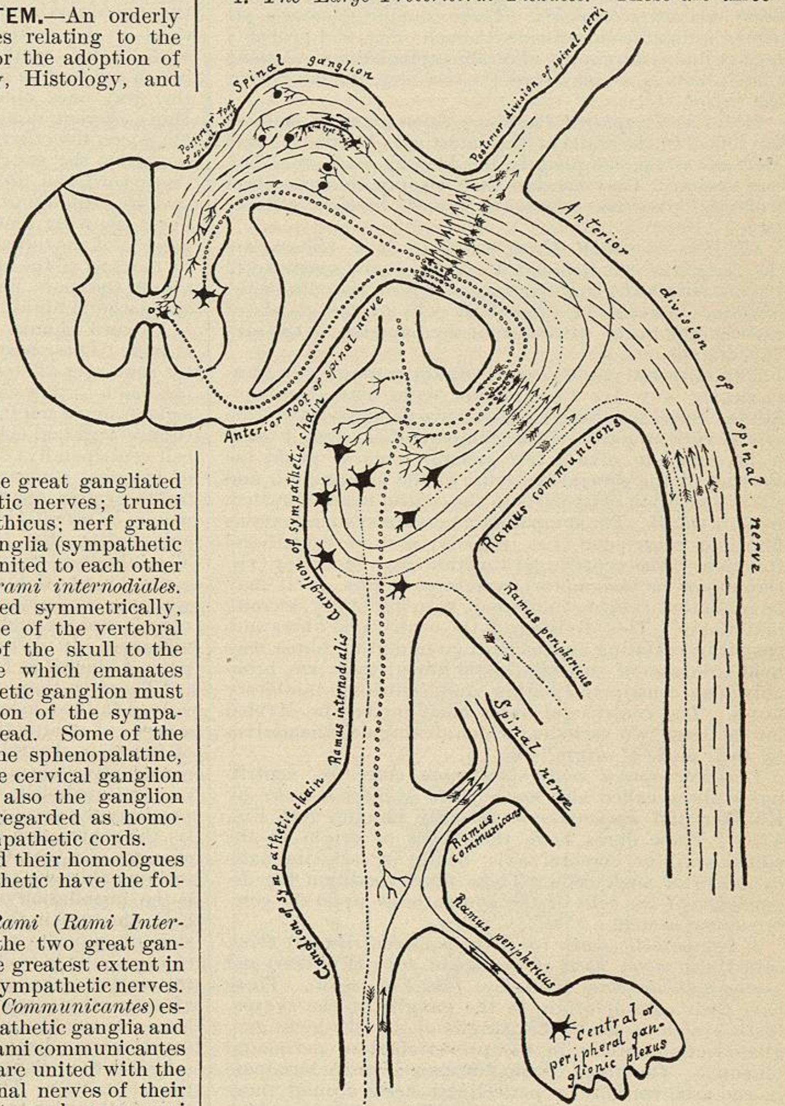

FIG. 4576.—Diagram of the Structural Interrelation between the Cerebro-spinal and Sympathetic Systems.

= Cerebro-spinal neurones of centrifugal functions.

= Cerebro-spinal neurones of centripetal functions.

= Sympathetic neurones of centrifugal functions.

= Sympathetic neurones of centripetal functions.

Marked "2nd type Dogiel" in the figure = the spinal ganglion cell of the second type of Dogiel.

in number, the *cardiac*, the *solar*, and the *hypogastric.* They are not bilateral but single, and lie all in front of the vertebral column, occupying the thorax, abdomen, and pelvis respectively. They are connected on the one hand with its cerebrospinal nerves and with the sympathetic cord, and on the other hand they form centres for the innervation of the viscera.

2. *The Smaller Plexuses of the Sympathetic.* Most of these are in intimate connection with the great prevertebral plexuses, and are in part directly continuous with them, forming, so to say, subdivisions of these. The remainder are united to the prevertebral plexuses by the nerve filaments or cords. These smaller plexuses are also in intimate connection with each other, and probably receive likewise a supply of cerebro-spinal fibres. Among these plexuses we may class the *coronary*, the *mesenteric*, the *vesical*, etc.

III. *The Peripheral Plexuses.*—Such plexuses as these are found in the walls of the intestines (Auerbach's and Meissner's), the œsophagus, the bladder, and other hollow viscera. They receive their supply of nerve fibres from the plexuses mentioned under division number two.

IV. *The Terminal Monocellular Ganglia.*—These are the ganglia which Ramon y Cajal has found scattered in the interstices of glandular tissues, within the villi of the intestines, among the interstitial cells of the glands of Lieberkühn, in the substance of the pancreas, in the salivary glands, etc.

THEORIES OF THE GENERAL STRUCTURE OF THE SYMPATHETIC AND ITS CONNECTION WITH THE CEREBRO-SPINAL SYSTEM.—Before passing to a detailed description of the various parts of the sympathetic system, I deem it necessary to give a few general remarks anent the theories of the general structure of the sympathetic and the interrelation of its parts to the central nervous system by fibre tracts. The sympathetic nervous system contains fibres of centripetal, *i.e.*, sensory, and of centrifugal function. The centrifugal function may be motor (viscero-motor or vaso-motor), secretory, trophic, or it may be inhibitory (viscero-inhibitory, vaso-inhibitory, secreto-inhibitory). This division of the centrifugal fibres into centrifugo-exciting and centrifugo-inhibiting fibres may hold true also of the centripetal fibres; these are probably also centripeto exciting and centripeto-inhibitory fibres. The centrifugal fibres must further be divided into at least two varieties, which distinguish themselves by their mode of origin.

1. *Cerebro-spinal motor* (or, more correctly, centrifugal) fibres, called also *motor fibres of the first order* by Kölliker, and *preganglionic fibres* by Langley (see Fig. 4576). These fibres have their cells of origin in the spinal cord or cerebral axis, being, in fact, the axis-cylinders of such cells. These fibres condition the dependence of the cells of the sympathetic upon the cerebro-spinal system.

2. *Sympathetic motor* (or in general centrifugal) *fibres*, called also *motor fibres of the second order* (Kölliker) and *post-ganglionic fibres* (Langley) (see Fig. 4576). These have their cells of origin in the ganglia of the sympathetic system, some in the ganglia of the two great gangliated cords, others in the prevertebral or peripheral plexuses. The fibres of the first-named order terminate in end-arborizations or pericellular nests around those nerve cells of the sympathetic ganglia or plexuses which give origin to fibres of the second order; in this manner the conduction of a motor impulse to the periphery is possible.

The existence of a third or fourth set of fibres is denied by Langley and Kölliker, but claimed by Jendrassik. The former two deny that the connection of the primary motor centre of the spinal cord or cerebral axis with the periphery is ever established by more than two sets of neurones, which the latter claims.

Jendrassik's ingenious theory of the general structure of the sympathetic cannot be discussed nor quoted in detail here, but must be read in the original (see literary references at the end of this article).

The views of the mode of origin of the sensory fibres of the sympathetic system and of the manner of their connection with the cerebro-spinal system are still divided. Kölliker claims that all sensory fibres of the sympathetic originate from cells of the spinal ganglia in exactly the same manner as do the sensory fibres of the cerebro-spinal system. Dogiel, on the other hand, is inclined to assume the existence of specific sympathetic fibres derived from cells of sympathetic ganglia or plexuses (see Fig. 4576, second type Dogiel). Researches by J. Collins and the writer confirm Dogiel's view.

The two kinds of motor fibres, the cerebro-spinal and the sympathetic, are represented in nearly all subdivisions of the sympathetic system. Both kinds are met with in the rami communicantes, the white rami of which are for the most part composed of cerebro-spinal, the gray ones chiefly of sympathetic fibres (Gaskell). Many efferent rami contain predominantly sympathetic fibres; on the other hand, those efferent rami which proceed from the ganglia of the thoracic part of the sympathetic cord and unite to form the splanchnic nerves are said by Langley to be for the most part cerebro-spinal fibres, showing that they pass through the sympathetic ganglia of the thoracic portion without being interrupted by the cells of the latter. Cerebro-spinal fibres are found also in the more peripheral plexuses, intermingled with sympathetic fibres.

A word should be said here regarding inhibitory nerves. These may be of the efferent (analogous to motor nerves) or afferent order (analogous to sensory nerves), inasmuch as they can display their inhibitory influence on a given nerve cell in both a descending (toward the centrifugally terminal cells) and an ascending (toward the same cell centripetally) direction. Such inhibitory nerves are of frequent occurrence. Indeed, wherever in the vegetative system one finds nerves performing motor, vaso-motor, or secretory functions, one also finds usually the antagonists, that is, nerves inhibiting such functions. The inhibitory nerves have been encountered again and again by physiologists, and for a long time their rôle was not understood. Gaskell, however, has given a very ingenious and plausible interpretation of their significance. In defining anabolism and catabolism he expresses himself as follows.

"There is, then, to my mind, no greater mystery involved in the conception of a nerve of *inhibition* than of a nerve of contraction. In the former case the cessation of function, the relaxation of tissue, is the symptom of constructive chemical changes going on in the tissue, *i.e.*, the anabolism or assimilation or trophic action, in precisely the same way as the activity of function, namely, the contraction of tissue, is a symptom of destructive changes, *i.e.*, catabolism or dissolution." Or, by transcribing this, we may say that the purpose of *inhibition* is the installation of restorative or constructive or anabolic changes in the tissue, while function is the expression of opposite changes, *i.e.*, destructive or catabolic changes. It is evident, however, that the installation of restorative changes after function (or perhaps even during function) is indispensable for the resumption of function. The rôle of inhibition seen in this light clearly gains great importance for the muscular, glandular, and other activities.

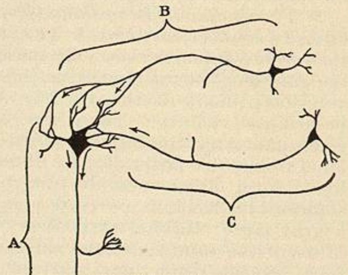

FIG. 4577.—Shows the Neurone *A* under the Exciting Influence of Neurones *B* and *C*. (The direction of the nerve current is indicated thus ⟶.)

The writer (Onuf, "A Tentative Explanation of Some of the Phenomena of Inhibition on a Histophysiological Basis, Including a Hypothesis Regarding the Function of the Pyramidal Tracts," *State Hospitals Bulletin*, 1897) has attempted to give an explanation of inhibition on a histophysiological basis, and has called attention to the regulative rôle that inhibition may have on certain functions. The theory

may be expressed in word and diagram (Figs. 4577 and 4578) as follows.

For the excitation of a nerve cell, the nerve current has to pass in the direction from the cell body or its protoplasmatic processes toward the nervous process; for the inhibition of the cell, the nerve current has to pass in the opposite direction, that is, from the nerve process or its collaterals, back to the cell body. In other words, to produce excitation of a given cell, the nerve current must enter this cell from the surface of its cell body or of its dendrites; but in order to inhibit or moderate the action of the cell, the nerve current has to enter the cell from its nerve process or collaterals thereof.

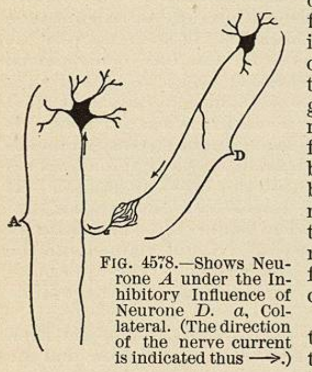

FIG. 4578.—Shows Neurone *A* under the Inhibitory Influence of Neurone *D*. *a*, Collateral. (The direction of the nerve current is indicated thus ⟶.)

These two modes of action are best illustrated by the diagrams (Figs. 4577 and 4578). For both figures the same neurone *A* has been chosen. Fig. 4577 shows this neurone *A* under the influence of excitation from the neurones *B* and *C*. Fig. 4578 represents neurone *A* under the influence of inhibitory action from the neurone *D*.

ANATOMY OF THE GANGLIATED CORDS.

We shall begin the detailed anatomical account with a description of *the two great gangliated cords.*

It is customary to distinguish four parts or portions of the great gangliated cords: the cervical, the thoracic, the lumbar, and the sacral. We shall describe these in this order, basing our description on that given by Thane (Quain's "Anatomy").

I. CERVICAL PART OF THE GANGLIATED CORD.—This is situated behind the great blood-vessels of the neck, resting on the muscles which cover the anterior surface of the vertebral column. The cervical part of the gangliated cord consists of three ganglia, as described below.

1. *Upper or Superior Cervical Ganglion.*—This, the largest ganglion in the great sympathetic cord, lies on the rectus anticus major muscle, opposite the second and third cervical vertebræ, behind the internal carotid artery, and to the inner side of the pneumogastric nerve. Usually fusiform in shape, it continues above into an ascending branch and tapers below into the connective cord. The following are the connections of this ganglion:

(*a*) *Connection with Spinal Nerves.* At its outer side the superior cervical ganglion is connected with the first four spinal nerves by means of gray rami communicantes. The branches to the third and fourth cervical nerves often pierce the rectus anticus major muscle. They may be given off from the upper part of the cord instead of directly from the ganglion. It probably consists primarily of several ganglia which have coalesced. Gaskell considers it to be a distal or collateral ganglion. It receives its cerebro-spinal fibres, which constitute the "cervical splanchnic nerve" of Gaskell, from the upper dorsal nerves to the cervical part of the sympathetic cord.

(*b*) *Connection with Cranial Nerves.* The ganglion or its cranial continuation is connected by small branches with the lower ganglion of the pneumogastric (ganglion cervicale vagi, plexus nodosus), and with the twelfth cranial nerve near the base of the skull. Another branch (N. jugularis), which is ascending, divides at the base of the skull into filaments, one of which ends in the petrosal ganglion of the glosso-pharyngeal nerve, while the others enter the jugular foramen to join the ganglion of the root of the pneumogastric.

Besides the branches connecting it with the cranial and spinal nerves, the first cervical ganglion gives off other ascending branches, viz., pharyngeal branches, the upper carotid nerve, and branches to the blood-vessels, as well as two or three filaments which pierce the prevertebral muscles to supply the upper cervical vertebræ and their ligaments.

(*c*) *Ascending Branch and Cranial Plexuses.* The ascending or carotid branch of the first ganglion (N. caroticus internus) is in some degree a prolongation of the ganglion itself. Ascending behind the internal carotid artery, it enters the carotid canal, dividing here into an external and internal division.

The *external division*, lying on the outer side of the internal carotid artery, distributes filaments to the latter, receives one or two carotico-tympanic twigs from the tympanic branch of the glosso-pharyngeal, and after communicating by means of other filaments with the internal division of the cord forms the carotid plexus.

The *internal division*, rather the smaller of the two and situated on the inner side of the internal carotid, supplies filaments to the carotid artery and goes to form the cavernous plexus. The terminal parts of these divisions of the cranial cord are prolonged on the trunk of the internal carotid and extend to the cerebral and ophthalmic arteries, around which they form secondary plexuses, those on the cerebral arteries ascending on the pia mater. One minute plexus enters the eyeball, accompanying the central artery of the retina.

The *carotid plexus* (plexus caroticus internus) is situated on the outer side of the internal carotid artery at its second bend (reckoning from below) or between the second and third bends. It forms connection with the sixth nerve and with the Gasserian ganglion (the latter, however, occasionally receiving its supply from the cavernous

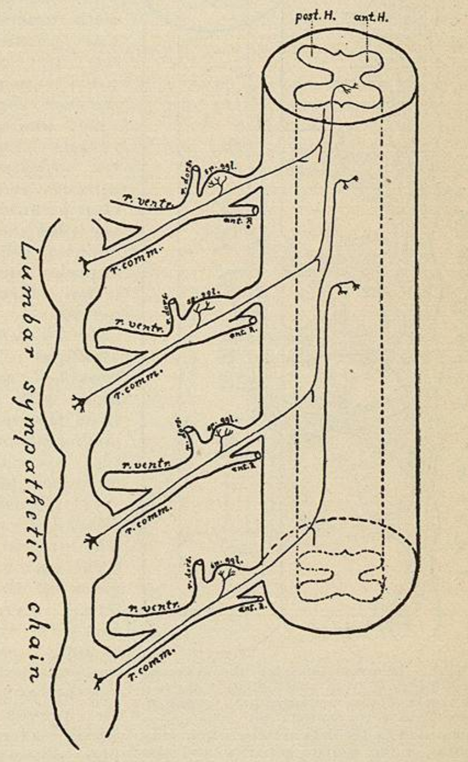

FIG. 4579.—Diagram to show the Ascent in the Spinal Cord of the Afferent (and probable Descent of the Efferent) Fibres derived from the Lumbar Sympathetic Chain, as resulting from the degenerations following removal of lumbar sympathetic ganglia. *post.H.*, Posterior horn; *ant. H.*, anterior horn; *r. ventr.*, ramus ventralis (anterior division) of lumbar nerve; *r. dors.*, ramus dorsalis (posterior division) of lumbar nerve; *sp. ggl.*, spinal ganglion; *ant. R.*, anterior root; *r. comm.*, ramus communicans.
For further details see p. 590.

plexus) gives off the large deep petrosal nerve, which together with the large superficial petrosal from the facial forms the Vidian nerve, and so joins the sphenopalatine ganglion. It further gives off the small deep petrosal nerve to the tympanic plexus, and supplies filaments to the internal carotid artery.

Cavernous Plexus.—This plexus, taking its name from its position in the cavernous sinus, is placed below and slightly to the inner side of the highest turn of the internal carotid artery. Besides giving branches to the artery and all its branches, *i.e.*, the ophthalmic, the anterior cerebral, the median cerebral, and the posterior communicating arteries, and to the walls of the sinus, it communicates with the third, fourth, and the ophthalmic divisions of the fifth cranial nerve. The latter connection supplies filaments to the ophthalmic trunk (inner side) of the fifth nerve, and the sympathetic root to the ciliary ganglion. The cavernous plexus also furnishes minute filaments to the pituitary body.

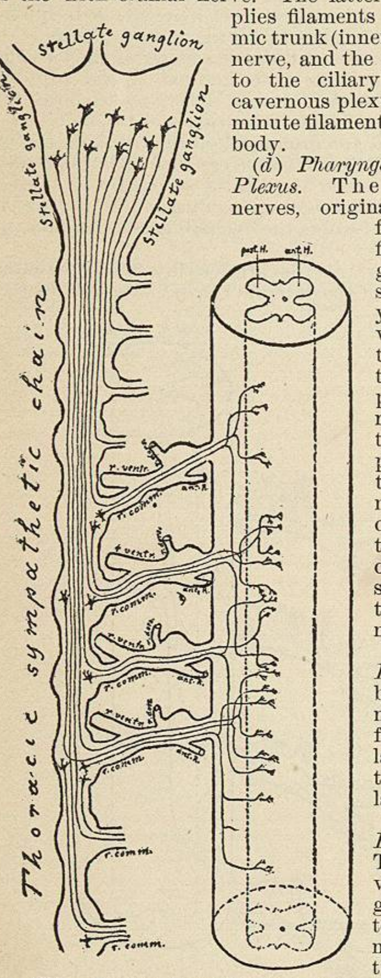

FIG. 4580.—Diagram showing the Afferent Fibres Derived from the Stellate Ganglion and Lower Thoracic Sympathetic Chain in their Course to the Spinal Cord. The course is suggested by the degenerations following removal of the stellate ganglion and also the lower thoracic sympathetic chain. The efferent fibres very likely have a similar course in opposite direction. *post.H.*, Posterior horn; *ant.H.*, anterior horn; *r. ventr.*, ramus ventralis (anterior division) of dorsal nerve; *r. dors.*, ramus dorsalis (posterior division) of dorsal nerve; *ant.R.*, anterior root; *r. comm.*, ramus communicans.
For further details see p. 590.

(*d*) *Pharyngeal Nerves and Plexus.* The pharyngeal nerves, originating from the forepart of the first cervical ganglion, pass to the side of the pharynx. They unite with branches of the pneumogastric and glossopharyngeal nerves, forming the pharyngeal plexus. The latter supplies the muscles and mucous membrane of the pharynx, and connects with the superior and external laryngeal nerves.

(*e*) *Laryngeal Branches.* These branches anastomose with twigs from the inferior laryngeal to form the so-called laryngeal plexus.

(*f*) *Branches to Blood-Vessels.* The superior cervical ganglion gives off the external carotid nerves, which, twining around the external carotid artery, form the plexus caroticus externus. This plexus is continued on the branches of the said artery. The fine plexuses then formed are named after the respective arteries. The plexus on the facial artery supplies a filament forming the sympathetic root of the submaxillary ganglion. The plexus on the middle meningeal artery connects with the otic ganglion and with the geniculate ganglion of the facial (external superficial petrosal nerve). One branch is given off to the parotid gland. Besides microscopical ganglia found in the vascular plexuses, several larger ones are more constantly met with, for instance, the temporal ganglion.

(*g*) *Upper (or Superficial) Cardiac Nerve.* This nerve, together with the middle and inferior cardiac nerves, goes to form the cardiac plexus. The left and the right nerves differ somewhat in their disposition, but in its course on the neck the right upper cardiac nerve has relatively the same position and relations as the left one, being placed in the back of the carotid sheath.

2. *Middle Cervical Ganglion.*—This ganglion is situated about opposite the sixth or seventh cervical vertebra. It is the smallest of the cervical ganglia. Gray branches unite it with the fifth and sixth cervical spinal nerves and with the superior and inferior cervical ganglia. It gives off thyroid branches, which form the inferior thyroid plexus and the middle cardiac nerve. The latter, in its course to the cardiac plexus, gives off filaments to the recurrent branch of the pneumogastric, to the upper cardiac nerve, and to the thyroid branches of the middle cervical ganglion.

3. *Lower or Inferior Cervical Ganglion.*—This ganglion is frequently united to the first thoracic ganglion, and the common mass is then designated as the first thoracic ganglion. Its shape is irregular, flattened. The ganglion is placed over the first costo-vertebral articulation in the lateral angle between the subclavian and vertebral arteries. Its union with the middle cervical ganglion is usually formed by a cord passing behind the vertebral artery, sometimes, however, especially on the left side, by a ring around the vessel. The two ganglia are also united by the ansa subclavia (ansa Vieussenii). The latter either passes as a single cord between the middle cervical and the lower cervical or first dorsal ganglion in front of the subclavian artery, or it forms a loop around that vessel, supplying it with small offshoots (plexus subclavius), which give off filaments to the internal mammary artery, communicating in some cases with the phrenic nerve.

The inferior cervical ganglion sends gray communicating branches to the lowest two cervical nerves, gives off the lower cardiac nerve (which passes behind the brachiocephalic artery on the right and behind the transverse aorta on the left side), and supplies twigs to the blood-vessels. The latter ascend along the vertebral artery, forming the vertebral plexus, the ultimate ramifications of which are continued on the intracranial branches of the vertebral and basilar arteries.

II. THORACIC PART OF THE GANGLIATED CORD.—The ganglia of the thoracic sympathetic are usually eleven in number, seldom twelve. The two thoracic sympathetic cords lie on either side of the spinal column over the costovertebral articulation, covered by the pleura, the third to the eleventh ganglia being generally placed over the heads of the ribs, the first one in the first intercostal space and the last one a little in front of the head of the twelfth rib. The first ganglion is often amalgamated with the lower cervical ganglion.

1. *Rami Communicantes.*—The branches connecting the thoracic sympathetic ganglia with the anterior divisions (rami ventrales) of the dorsal nerves are usually two in number for each ganglion, one of these being white and the other gray.

2. *Interfunicular Rami.*—Branches establishing a connection of the two thoracic sympathetic cords between each other are often found, but their occurrence is not constant.

3. *Peripheral Branches of the Ganglia.*—The upper four or five ganglia send small branches to the vertebræ and ligaments and to the descending thoracic aorta, on which latter, by union of the branches from the ganglion with filaments from the great splanchnic nerve, they form the plexus aorticus thoracalis. The second, third, and fourth ganglia also supply branches to the posterior pulmonary plexus, formed otherwise chiefly by ramifications of the pneumogastric nerve.

The rami proceeding from the lower six or seven ganglia join to form three cords on either side, known as the

great, the small, and the smallest splanchnic nerves (abdominal splanchnics of Gaskell), which pass into the plexuses of the abdomen.

4. *The Great Splanchnic Nerve.*—The roots uniting to form this nerve are those furnished by the fifth or sixth thoracic ganglion and all the succeeding ganglia to the

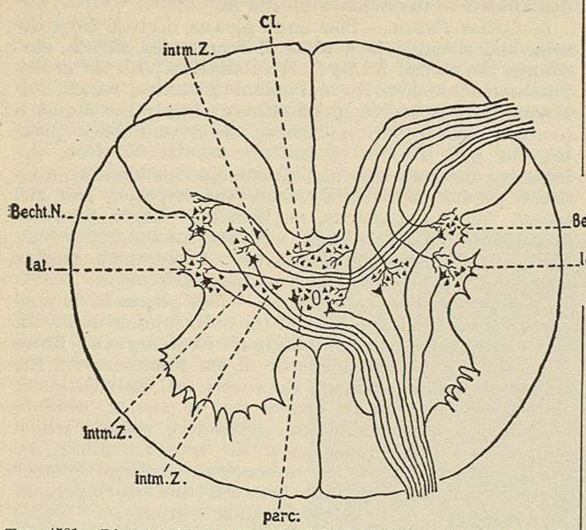

FIG. 4581.—Diagram Illustrating the Spinal Representation or Localization of the Sympathetic Nerve as made very probable from the Degenerations following lesions of the sympathetic chain. *Cl*, Clarke's column; *intm.Z.*, intermediate zone; *Becht.N.*, Bechterew's nucleus; *lat.*, lateral horn group; *parc.*, paracentral group.
See also p. 590.

ninth or tenth (inclusive). The nerve descends over the bodies of the dorsal vertebræ, passing mesiad of the gangliated cord, and, after perforating the crest of the diaphragm, terminates in the upper part of the semilunar ganglion, and sometimes, with a few fibres, in the suprarenal body and the renal plexus. The nerve contains a large part of medullated cerebro-spinal fibres, which give it a white color. They may be traced upward from the highest root along the sympathetic cord as far as the third thoracic ganglion or nerve, or even higher. The great splanchnic nerve often forms a plexus with the small splanchnic nerve, having in many cases a small ganglion (splanchnic ganglion) in its course. The greater splanchnic nerve and the splanchnic ganglion supply the vertebræ and the aorta with filaments.

5. *The Small Splanchnic Nerve.*—The thoracic ganglia giving origin to this nerve are the ninth and tenth, or sometimes the tenth and eleventh. It perforates the diaphragm with or somewhat behind and to the right of the great splanchnic, terminating in the lower part of the semilunar or occasionally in the aortico-renal ganglion. In the thorax anastomoses with the smallest splanchnic are often present.

6. *The Smallest Splanchnic Nerve* (N. renalis posterior of Walter) takes its origin from the last thoracic ganglion and communicates sometimes with the small splanchnic. It pierces the diaphragm with the cord of the sympathetic, and ends in the renal plexus. It is frequently absent as a separate individual nerve, being in this case represented by a branch of the small splanchnic.

The three splanchnic nerves are composed for the most part of cerebro-spinal fibres.

III. LUMBAR PART OF THE GANGLIATED CORD.—The two lumbar sympathetic cords lie in rather close proximity to each other on the bodies of the lumbar vertebræ, along the inner border of the psoas muscle. Their position is extraperitoneal, the right one being partly covered by the vena cava, the left one by the aorta. Each lumbar cord contains usually four ganglia, but sometimes only three or even only two.

1. *Rami Communicantes.*—As a rule, each of the ganglia of the lumbar sympathetic has two rami communicantes, which, however, are not always connected with the same spinal nerves.

2. *Rami Interfuniculares.*—These are also inconstant in their occurrence, although more constant than in the thoracic part of the gangliated cords.

3. *Peripheral Branches.*—These branches, varying in number, are distributed to the plexus on the aorta, to the hypogastric plexus, and to the vertebræ and ligaments connecting the latter.

IV. SACRAL PART OF THE GANGLIATED CORD.—This is placed in front of the sacral bone along the inner side of the foramina sacralia, the two sacral cords converging correspondingly toward the coccyx. Each cord has usually four ganglia, but quite frequently less. Only few branches are given off to the viscera.

1. *Rami Interfuniculares.*—Fine branches uniting the two cords are of constant occurrence here, especially at the lower end, where they form a loop in which a single median ganglion, ganglion impar, or coccygeal ganglion, is often found. The interfunicular rami send off fine filaments into the vertebral bodies, to the coccyx and the coccygeal gland.

2. *Rami Communicantes.*—These are short, often two for one ganglion, frequently united to different sacral nerves. The last or coccygeal ganglion sends a communicating branch to the coccygeal nerve.

3. *Peripheral Branches.*—Only small and few peripheral branches are given off from the sacral ganglia. They are distributed to the sacral bone, to the pelvic plexus, and to the middle sacral artery, on which some of them form a plexus.

THE ANATOMY OF THE PLEXUSES.

I. CARDIAC PLEXUS.—This plexus lies against the transverse aorta and pulmonary artery where these vessels are in contact. It is supplied by the cardiac branches from the cervical ganglia and by those of the pneumogastric nerves. It gives origin to nerves distributed to the heart and to others participating in the innervation of the lungs. That part of the cardiac plexus which is situated chiefly behind the vessels is called the deep cardiac plexus, while the one that lies more in front

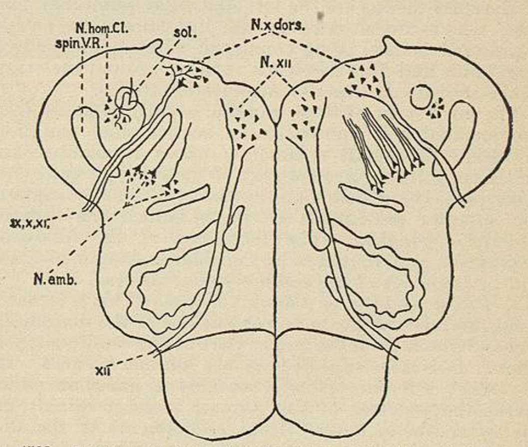

FIG. 4582.—Diagram to show the Relation of the So-called Lateral Mixed System of Nerves (*IX,X,XI* roots) with the vagoglossopharyngeal nucleus, with the nucleus ambiguus, with the solitary bundle, and with a nucleus which we consider to be the homologue of Clarke's column. These relations are suggested among other things by the changes in the oblongata following removal of the stellate ganglion. *N.X dors.*, Dorsal vagus nucleus or vago-glossopharyngeal nucleus, so-called, = nucleus for the visceral or vegetative efferent fibres of the lateral mixed system (*IX,X,XI* nerves); *IX,X,XI* common root of the *IX,X,XI* nerves (= lateral mixed system); *N.amb.*, nucleus ambiguus = nucleus for the somatic efferent fibres of the lateral mixed system (*IX,X,XI* nerves); *sol*, solitary bundle, called also trineural fascicle or descending root of the lateral mixed system; *N.hom.Cl.*, nucleus homologue of Clarke's column; *N.XII*, hypoglossal nucleus; *XII*, hypoglossal nerve; *spin.V.R.*, spinal trigeminal root.
See also p. 590.