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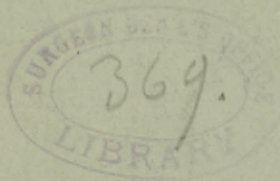
The Glosso-pharyngeal, the Accessory and the
Hypoglossal Nerves

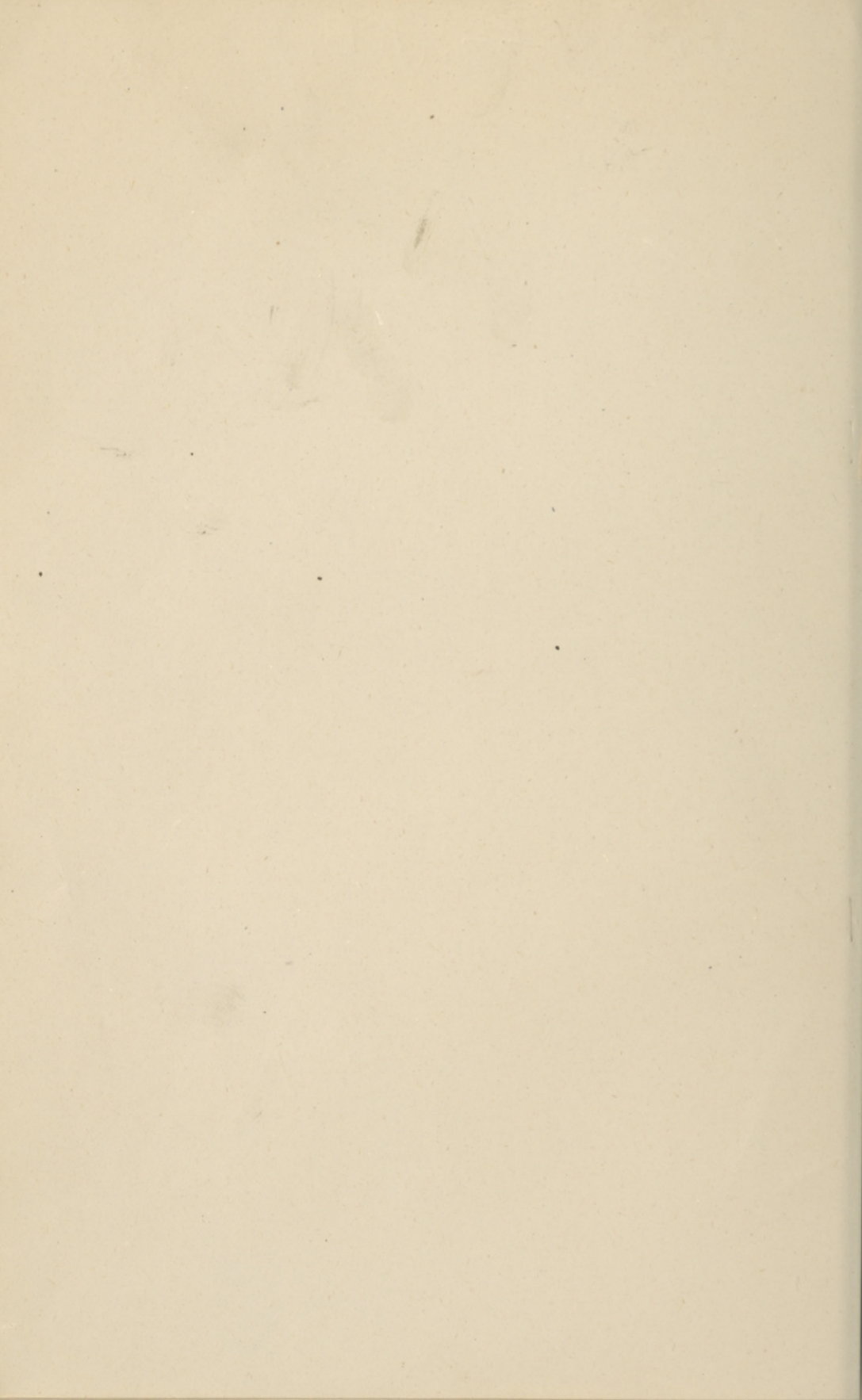
IN THE

DOMESTIC CAT.

T. B. STOWELL, A.M., Ph.D.

Read before the American Philosophical Society, March 2, 1888.





With compliments of the Author.

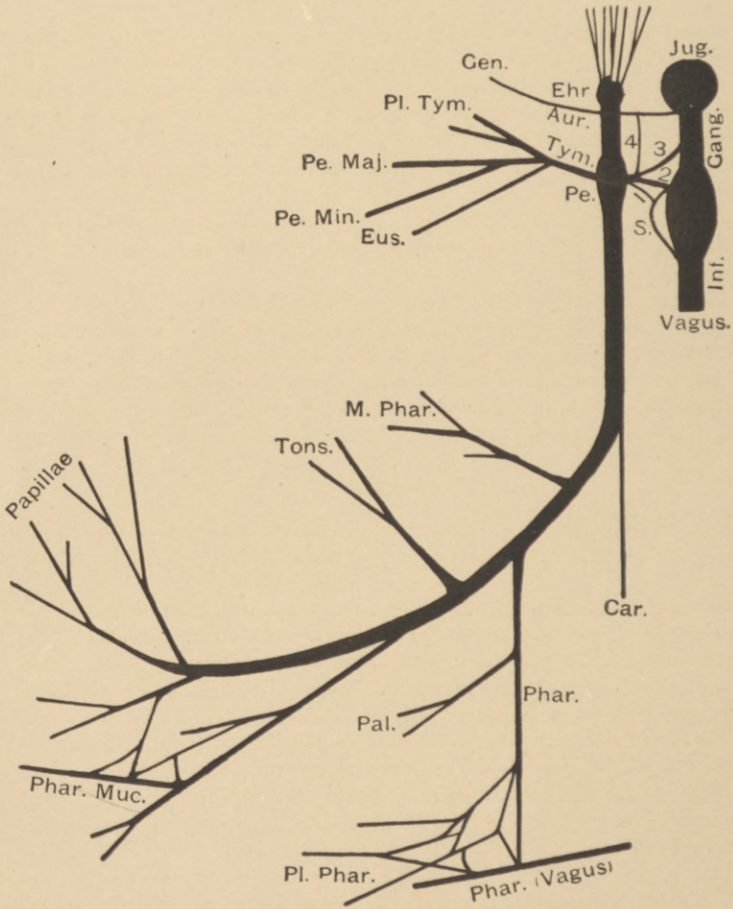


Diagram of the Glosso-pharyngeal Nerve.—Stowell.

*The Glosso-pharyngeal Nerve in the Domestic Cat.*By *T. B. Stowell, A.M., Ph.D.**(Read before the American Philosophical Society, March 2, 1888.)*

Introduction.—The following study in comparative neurology is a continuation of the contributions made by the author and already published in the Proceedings of the Society. [The Vagus Nerve in the Domestic Cat (*Felis domestica*), read July 15, 1881; The Trigeminal Nerve in the Domestic Cat, read May 21, 1886; The Facial Nerve in the Domestic Cat, read Nov. 5, 1886.] The object of these contributions has been presented in the previous papers.

I am not aware that any one has published the detailed distribution and relations of this nerve; this study is therefore offered as a contribution to comparative neurology.

Preparation.—As previously recommended, the cats were injected with the "starch injection mass." The dissections have been verified upon alcoholic and upon recent specimens; the nerves have been traced under a magnifying power of 15–25 diameters. It is hoped that such a degree of accuracy has been attained as will render this study serviceable to students of the nervous system.

DESCRIPTION.

Synonymy.—Nervus glosso-pharyngeus, N. pharyngo-glossus, Glosso-pharyngeal nerve, Eighth pair of cranial nerves (Willis), Ninth pair (Sommering).

General Characters.—The N. glosso-pharyngeus is the cephalic member of a group of nerves whose ectal origin is along a line caudad of the eminentia auditoria and dorsal of the area elliptica. The common niduses in man from which the ental fibres of these nerves arise have been designated the "nuclei of the lateral mixed system" (28, p. 747).

The N. glosso-pharyngeus is characterized by the presence of two ganglia upon the central portion of the nerve-trunk, the central one (Fig. Ehr.) is within the foramen of exit (Fm. jugulare), the peripheral one (Fig. Pe.) is about 7 mm. peripherad of the foramen. The presence of the root ganglion and the ental origin ally this nerve and the dorsal roots of the myelic nerves.

The glosso-pharyngeus is specifically the sensory nerve of the pharynx, of the mucosa of the tympanum, and of the basal (circumvallate?) papillae of the tongue. It includes motor fibres which are given to the cephalic pharyngeal constrictor and to the stylo-pharyngeus muscles. Communicating rami connect the N. glosso-pharyngeus with the N. vagus, the N. sympathicus, the G. oticum, and with the N. facialis.

The glosso-pharyngeus is peculiarly the nerve of deglutition as well as the nerve of taste. The importance of having these functions associated



in the same nerve appears when the relation of food-stuffs to life is considered. The inverted muscular reaction which ensues upon the application of an unnatural or irritating stimulus is another characteristic of this nerve.

The conflicting evidence of Bell, Longet, Panizza, Reid, Mayo, Bernard, Chauveau, and other experimenters, leaves grave doubt as to the susceptibility of the N. glosso-pharyngeus to receive painful impressions.

I am not aware that the function of the tonsillar branch has been demonstrated.

Ectal Origin.—The ental roots (5-6 funiculi) constitute a small nerve-trunk whose ectal origin is in the depression line dorsad of the oliva, the line of origin of the dorsal roots of the N. vagus [indeed, the cephalic funicle of the vagus seems to belong to the root funiculi of the glosso-pharyngeus]. The trunk so formed lies ventrad of the plexus choroideus lateralis and passes laterad to the foramen of exit.

Foramen of Exit.—The nerve takes its exit from the cranium through the foramen jugulare in connection with the vagus and the accessorius nerves, the jugular vein, and a small arteriole from the A. occipitalis.

Intercranial Course and Root Ganglion.—In the passage through the jugular fossa the sheath of the N. glosso-pharyngeus is distinct from and cephalad of the common sheath of the vagus and the accessorius and is separated by the arteriole above referred to. At the central end of the fossa the N. pharyngeus bears a small pinkish ganglion (G. ehrenritteri, G. nervi glosso-pharyngei superius, G. jugulare superius, G. mulleri). This ganglion lies upon the ectal surface and the ventral border of the G. jugulare of the N. vagus, but it does not appear to have structural relations with the ganglion. The ganglion (G. Ehr.) is ectal and does not involve all of the fibres of the trunk.

Plexus gangliformis, Pl. nodosus.—The central 5 mm. of the ectocranial trunk are closely apposed to, if not involved in the somewhat intricate network of vessels and tissues which characterize this region and form the gangliform or nodose plexus (Fig. Gang.). The apposed trunks of the glosso-pharyngeus, the vagus, the accessorius, the hypoglossus, and the sympathetic nerves by a peculiar interlacing of fibres and by anastomotic rami sustain intimate inter-relations. There is reason for thinking that through this plexus, the glosso-pharyngeus is connected with the accessorius (the complications involved in identifying rami in this plexus leave some doubt regarding the precise structure of this plexus). The glosso-pharyngeus is ectal in this group and is possibly separable from the ental nerves.

G. petrosum and its Communicating Rami.—At the caudal border of the plexus gangliformis the glosso-pharyngeus presents a fusiform enlargement, the ganglion petrosum (Fig. Pe.), ganglion of Andersch. This is the ganglion of the trunk and is about 2 mm. \times 1 mm.; it seems to involve the entire nerve-trunk. Its communicating rami are five, as follows:

1. A large ramus to the dorso-cephalic border of the G. inferius of the N. vagus (Fig. 2). 2. A small ramus to the adjacent sympathetic ganglion (G. cervicale cephalicum, Fig. 1). 3. A branch to the plexus, some fibres of which are apparently traceable to the N. accessorius, in the second or large accession from that nerve to the vagus (Fig. 3). 4. A slender filament (Fig. 4) to the auricular branch (Fig. Aur.) which joins the jugular ganglion of the vagus with the geniculate ganglion of the facialis. The auricular ramus crosses the ectal surface of the glosso-pharyngeus just peripherad of the G. ehrenritteri and receives the anastomotic filament from the G. petrosum at a point opposite the nerve-trunk (this filament is frequently broken in dissecting the plexus). These four rami are given off from the ental surface of the G. petrosum as a single trunk or as several closely apposed rami. 5. A large branch, the tympanic (Fig. Tym.) which lies in a fossa entad of the ectal bulla together with a branch from the sympathetic. This branch divides in the fossa, into four ramuli, as follows: *a.* One (Fig. Pe. maj.) becomes one of the roots of the great superficial petrosal, which in turn is one of the roots of the vidian nerve. *b.* A second (Fig. Pe. min.) is one of the roots of the small superficial petrosal and terminates in the otic ganglion. *c.* A third (Fig. Eus.) forms a plexus around the eustachian tube. *d.* The fourth (Fig. Pl. tym.) forms, with the sympathetic, the tympanic plexus upon the ectal surface of the promontory, from which filaments are traceable to the fenestra rotunda and the F. ovalis.

Principal Rami.—Peripherad of the G. petrosum the nerve-trunk bends around the ventral surface of the ectal bulla and lies apposed to an arteriole, a ramulus from the A. occipitalis. 8 mm. peripherad of the ganglion it gives the first ramus of the trunk (Fig. car.), caudad to the plexus carotideus about the ectal origin of the A. occipitalis. 6 mm. peripherad of this ramus, a branch is sent dorsi-mesad to the sphincter muscles of the pharynx (Fig. M. phar.)—this ramus seems to be the only distinctively muscular branch of this nerve; filaments are also given to the M. stylo-pharyngeus. It is through this ramus that the N. glosso-pharyngeus controls deglutition (the palatal branch, q. v., may possibly reach muscular fibre in the palatal region, corresponding to the M. palato-glossus, and the M. palato-pharyngeus. I have not satisfactorily identified these muscles).

N. pharyngeus.—At the origin of the muscular ramus just described a large ramus, N. pharyngeus (Fig. Phar.), is directed ventrad and caudad; this ramus, about 5 mm. peripherad of its origin, divides into two ramuli, the cephalic one (Fig. Pal.) is distributed to the pharynx in the palatal region; the caudal ramulus forms a dense plexus (Fig. Pl. Phar.) with the pharyngeal branch of the vagus nerve (Fig. Phar. Vagus) upon the pharyngeal mucosa laterad of and adjacent to the epiglottis.

A second pharyngeal ramus (Fig. Phar. muc.) is given off 10 mm. peripherad of the first; this is distributed to the mucosa laterad of the base of the tongue. A third branch is given off about 5 mm. still peripherad, which unites in the pharyngeal plexus upon the mucosa.

N. tonsillaris.—About 10 mm. peripherad of the first R. pharyngeus a ramus (Fig. Ton.) is given to the tonsil and to its enveloping capsule. The function of this nerve is not known.

N. papillaris.—The terminal filaments (F g. Papillæ) may be traced to the long papillæ (circumvallate?) 15 mm. peripherad of the Os hyoides, upon the base of the tongue. These filaments are in the most restricted sense, the nerves of taste.

SUMMARY.

A. ANATOMICAL.

Ectal Origin.—By 5-6 funiculi in the depression line caudad of the eminentia auditoria, dorsad of the oliva and cephalad of the dorsal roots of the N. vagus.

Foramen of Exit.—Foramen jugulare.

Intercranial Course.—In the passage through the jugular fossa, the N. glosso-pharyngeus is the cephalic one of the structures which traverse the foramen. At the central end of the fossa, the nerve bears a ganglion, the G. ehrenritteri, which is ectal in position and does not involve the entire trunk.

Ectocranial Trunk.—The first 5-7 mm. of the ectocranial trunk are intimately associated with the plexus gangliformis which involves the central portions of the vagus, the accessorius, the hypoglossus, and the sympathetic nerves, from which plexus it is generally distinct, although it contributes a considerable ramus (possibly this is an accession to the glosso-pharyngeus from the accessorius). 7 mm. peripherad of the foramen of exit the nerve is involved in a small fusiform ganglion.

G. petrosum and its Communicating Rami.—This fusiform ganglion involves the entire nerve-trunk; it is easily overlooked in the enveloping connective tissue and the adjacent plexus. From its ental surface a single trunk or four adjacent anastomotic rami take their ectal origins as follows: the ventral one to the cephalic cervical ganglion of the N. sympathicus; one just caudad and the largest joins the G. inferius of the vagus nerve; dorsad of this ramus the second in size is given to the plexus gangliformis, a portion of which seems to be traceable to the N. accessorius; the dorsal slender filament joins the ramus auricularis from the root ganglion, G. jugulare, of the vagus to the geniculate ganglion of the N. facialis. From the cephalic border of the ganglion the large tympanic branch, or Jacobson's nerve, lies in a fossa entad of the ectal bulla tympanica adjacent to a branch from the cervical sympathetic ganglion. The tympanic nerve divides into four branches as follows: one of the roots of the great superficial petrosal nerve, the principal root of the small petrosal nerve which terminates in the otic ganglion, a slender filament which joins the eustachian plexus, and the branch to the tympanic plexus.

Principal Rami.

1. *Muscular*; a branch to the pharyngeal constrictor muscles (Fig. M. Phar.) has its ectal origin about 14 mm. peripherad of the G. petrosum.

2. *Pharyngeal*; three rami from the ventral border of the nerve-trunk to the pharyngeal mucosa.

3. *Tonsillar*; a branch, 10 mm. peripherad of the muscular ramus, to the tonsil and its enveloping capsule.

4. *Terminal*; to the long papillæ at the base of the tongue.

5. *Communicating and anastomotic*;

At the G. petrosum with the G. cervicale cephalicum (sympathicus).

“ “ “ “ G. inferius (vagus).

“ “ “ “ plexus gangliiformis.

“ “ “ “ R. auricularis.

“ “ “ “ it is the origin of the tympanic nerve (Jacobson).

To the plexus carotideus at origin of the A. occipitalis.

In the plexus pharyngeus with the N. pharyngeus (vagus).

B. PHYSIOLOGICAL.

The N. glosso-pharyngeus is the sensory nerve of the pharynx; it is the special sense nerve of taste; it controls deglutition, and when abnormally irritated excites an inverted muscular action in the muscles of the stomach and œsophagus, inducing vomiting; it does not seem to be susceptible of painful sensations.

EXPLANATION OF THE DIAGRAM.

The diagram is not drawn to a scale. It has been the author's aim to present in definite form the principal structures and relations, combining simplicity and clearness. Aur., the auricular branch from the jugular ganglion of the vagus nerve to the geniculate ganglion of the facial. This nerve crosses the ectal surface of the glosso-pharyngeus just ventrad of the root ganglion. Car., the anastomotic nerve to the carotid plexus around the ectal origin of the A. occipitalis. Ehr., the ganglion Ehrenritteri, or ganglion of the root. Eus., the branch which forms with the sympathetic a plexus upon the eustachian tube. Gang., the plexus gangliiformis, or plexus nodosus. Gen., the position of the geniculate ganglion of the facial nerve. Inf., the ganglion inferius or ganglion of the trunk of the vagus nerve. Jug., the ganglion jugulare or root ganglion of the vagus. M. phar., the muscular ramus to the pharyngeal constrictors. Pal., the branch of the pharyngeal nerve which is distributed to the mucosa in the region of the soft palate, and possibly to the palatal muscles. Papillæ, the terminal filaments of the papillary ramuli which are given to the long papillæ characteristic of the dorsal surface of the base of the tongue. Pe., the ganglion petrosum or ganglion of the trunk. Pe. maj., the branch of the tympanic nerve which becomes one of the roots of the great superficial nerve. Pe. min., the branch of the tympanic which becomes the small petrosal nerve and terminates in the otic ganglion. Phar., the pharyngeal ramus which joins the pharyngeal nerve from the vagus to form the pharyngeal plexus. Phar. muc., the rami which form the plexus over the pharyngeal mucosa. Phar. vagus,

the N. pharyngeus, a branch of the vagus. Pl. phar., the plexus pharyngeus. Pl. tym., the tympanic plexus over the promontory of the tympanum. S., the cephalic cervical ganglion of the sympathetic ganglion, just entad and cephalad of the G. inferius. Ton., the tonsillar branch. Tym., the tympanic ramus or Jacobson's nerve. Vagus, the central 10 mm. of the vagus nerve, showing the relations of the ganglia. 1. Anastomotic filament from G. petrosum to S. 2. Communicating branch to the G. inferius. 3. Branch to the plexus gangliformis; this is the doubtful accession from the N. accessorius. 4. Anastomotic filament to the R. auricularis.

BIBLIOGRAPHY.

For bibliography consult previous papers. The Trigemini Nerve in the Domestic Cat; Proceedings of the American Philosophical Society, Vol. xxiii, pp. 459-478; 1886. Also, The Facial Nerve in the Domestic Cat; Proceedings of the American Philosophical Society, Nov. 5, 1886.

The Accessory Nerve in the Domestic Cat. By T. B. Stowell, A.M., Ph.D.

(Read before the American Philosophical Society, March 2, 1888.)

Synonymy.—N. accessorius; Accessory of the Par Vagus; Accessory nerve of Willis; Spinal accessory; Superior respiratory; Eleventh pair of encephalic nerves.

General Characters.—This nerve is called accessory because of its large accessions to the N. vagus, in the G. jugulare and in the plexus just peripherad, v. description below; it is called myelic and spinal from the fact of its widely distributed origin along the cervical myel, v. below. The nerve is an attractive study alike to the anatomist and to the physiologist; its origin, distribution, terminal plexuses and its action upon respiratory movements, laryngeal phonation and the heart are equally distinctive. It combines a large group of myelic funiculi with a few from the medulla; by virtue of its accessions to the Vagus it sustains structural relations with the N. pharyngeus and with the N. laryngeus caudalis (Rami of the Vagus), indeed a large share of the motor fibres of the Vagus is referable to the accessions from the Accessorius [Longet, *Système Nerveux*, t. ii, p. 265; Cl. Bernard, *Leçons sur la Physiologie du Système Nerveux*, t. ii, p. 244]; by an anastomotic ramus it joins the N. hypoglossus, and in its terminal filaments it makes numerous plexuses with the cervical myelic nerves. M. Claude Bernard by his method of evulsion demonstrated that laryngeal phonation is due to the action of the accessory nerve. The prolonged cries of many mammals seem to confirm his conclusions and are due, in part, at least, to the rigidity of the cervical muscles in sustained expiratory movements. According to Heidenhain, this accession gives cardio-inhibitory fibres to the Vagus.

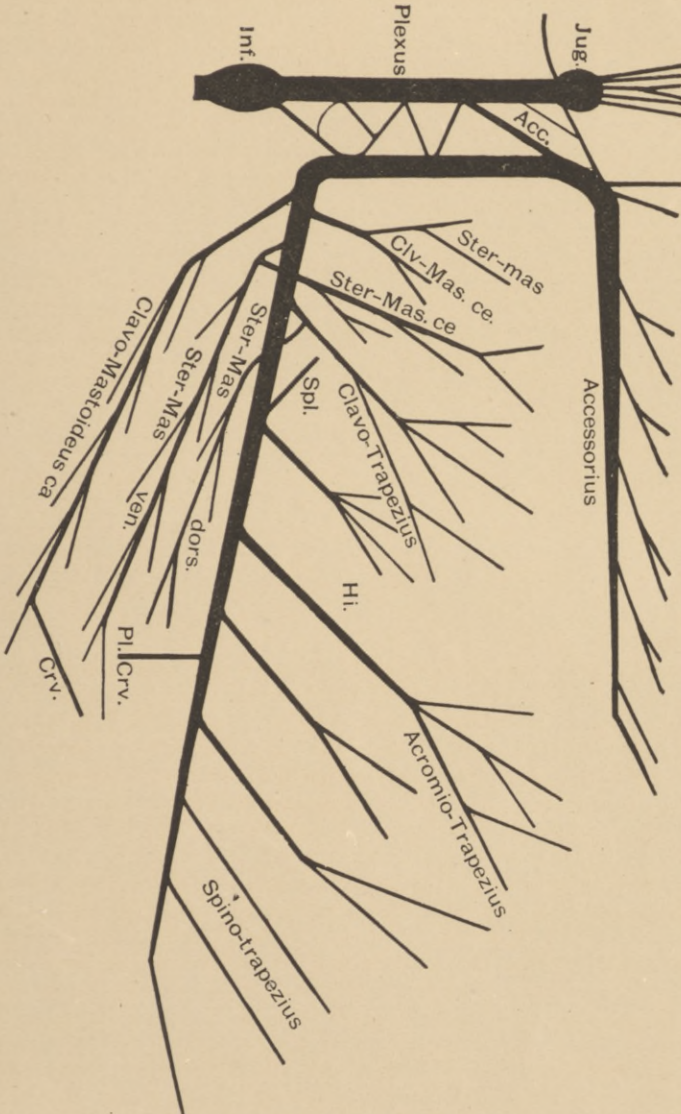


Diagram of the Accessory Nerve.—Stowell.

DESCRIPTION.

Ectal Origin and Entocranial Course.—The *N. accessorius* is peculiar in its two-fold origin, the medulla and the myel; the cephalic roots arise in the depression line dorsad of the area ovalis and immediately caudad of the dorsal roots of the *N. vagus*; the caudal roots arise along the lateral column of the cervical myel, as far caudad as the fifth cervical vertebra (fibres are not infrequently traceable along the entire cervical myel). The confluence of these funiculi forms a nerve trunk whose volume increases from its caudal origin to the foramen of exit. The nerve trunk thus constituted lies entad of the myelic dura opposed to the lateral column of the myel, between the dorsal and the ventral roots of the myelic nerves; its course is cephalad and enters the cranium through the foramen magnum; at the caudal border of the ectal roots of the *N. vagus*, the *N. accessorius* turns laterad and perforates the dura just caudad of the *Vagus* (I have not met with two entocranial trunks, as is sometimes the case in man), and takes its exit from the cranium through the foramen jugulare in the common sheath with the *Vagus* and the adjacent *Glossopharyngeus*.

Just centrad of the foramen of exit the *Accessorius* is closely opposed to the *G. jugulare* (*Vagus*), to which ganglion it gives a large ramus. This is the so-called accessory or motor root of the *N. vagus*.

Intercranial Relations and Foramen of Exit.—The *N. accessorius* traverses the jugular fossa, in which it lies caudad and laterad of the *N. vagus*, but apparently in a common sheath with that nerve (additional histological research may disclose a separate sheath for each nerve), and leaves the cranium by the foramen jugulare.

Ectocranial Trunk.—The first 5–10 mm. of the ectocranial trunk are involved in the dense plexus, *Pl. gangliformis* or *Pl. nodosus* (Fig. *Plexus*), with the *Vagus*. This plexus is formed by interlacing fibres of the *Vagus*, the *Accessorius*, a few fibres from the *Hypoglossus*, with numerous embracing and intertwining filaments of the *N. sympathicus*, and the vessels of this region; it is highly probable that the adjacent *N. glossopharyngeus* with its *G. petrosum* is involved in this plexus.

Peripherad of the plexus, the *N. accessorius* lies entad of the *A. occipitalis* and the *V. jugularis* (a ramule of the *A. occipitalis* is dorsi-laterad of the nerve in its ecto-cranial course as far as the *A. occipitalis*). At the caudal border of the *A. occipitalis*, the *Accessorius* bends dorsi-caudad, accompanied by a small arteriole and perforates the *M. clavo-mastoideus* near its dorsal border, 20–25 mm. caudad of the insertion of the muscle; this point is also dorsad of the cephalic end of the thyroid body.

PRINCIPAL RAMI.

N. clavo-mastoideus.—As the *Accessorius* perforates the *M. clavo-mastoideus* a large ramus (Fig. *Clv.-Mas. ca.*) is given to that muscle; it is accompanied by an arteriole, lies upon the ental surface of the muscle,

and may be traced to the caudad extremity (origin) of the muscle, where it is joined by the anastomosing filaments of the cervical nerves (Fig. Crv.). From the dorsal border of the nerve at nearly the same point a corresponding ramus (Fig. Clv.-Mas. ce.) is given to the cephalic end (insertion) of the same muscle; this ramus also innerves the adjacent cephalic extremity of the M. sterno-mastoideus (Fig. Str.-Mas.).

N. sterno-mastoideus.—Upon the ectal surface of the M. clavo-mastoideus a large ramus from the Accessorius enters the ental surface of the superposed sterno-mastoid muscle. *The shorter or dorsal division* of this ramus (Fig. Ster.-Mas. ce.) lies ectad of the trunk of the Accessorius and supplies the cephalic (insertion) third of the muscle, or that portion cephalad of the point of init of the nerve; *the ventral division* (Fig. Str.-Mas. ven.) is distributed to the thick ventral border of the caudal two-thirds of the same muscle. About 5 mm. peripherad, or at the dorsal border of the M. sterno-mastoideus, where the muscle is crossed by the large trunk of a cervical nerve (2^c), a second ramus (Fig. Str.-Mas. dors.) is given from the Accessorius to the thin dorsal border of the caudal portion of the same muscle. This ramus lies ectad of the cervical nerve and receives from it a large accession. Since this muscle has two sources of nerve-supply, there is throughout the caudal portion of the muscle a more or less frequent anastomosis of terminal filaments.

N. clavo-trapezius cephalicus.—This ramus is given off in connection with the dorsal ramus of the N. sterno-mastoideus; it lies ectad of an artery which supplies the cephalic 20 mm. of the M. clavo-trapezius. The nerve enters the ental surface of the ventral border of the muscle, with the artery just named, and sends a ramulus 5–10 mm. caudad of the artery and is distributed to the cephalic fourth of the muscle; the terminal filaments of the nerve may be traced to the dorsi-meson. Near its ectal origin this nerve receives an anastomotic branch from the second cervical nerve.

The main nerve trunk lies ectad of the M. clavo-trapezius, crosses the ectal surface of the M. levator claviculæ and continues dorsad of the levator muscle upon the ectal surface of the M. splenius. At the ventral border of the M. clavo-trapezius the N. accessorius receives a large branch from the second cervical nerve which crosses its ectal surface in this region. At the dorsal border of the M. levator claviculæ it sends a slender ramus (Fig. Spl.) to the cephalic portion of the M. splenius.

N. clavo-trapezius caudalis.—About the middle of the M. clavo-trapezius, a large ramus, the N. clavo-trapezius caudalis, separates from the Accessorius and divides into three or four ramuli which enter the ental surface of the M. clavo-trapezius to be distributed to that portion of the muscle which lies dorsad of the M. levator claviculæ.

Between the clavo-trapezius and the acromio-trapezius muscles, upon the side of the neck, and dorsad of the levator muscle, is a narrow intermuscular interval, the *hiatus trapezii* (Fig. Hi.), filled with adipose, connective tissue, a large lymphatic, an artery, the accessory nerve and the cervical plexus of the second and third myelic nerves.

N. acromio-trapezius.—In this hiatus a large ramus (Fig. caudad of Hi.) is sent dorsad to the M. acromio-trapezius, which enters the cephalic border of the muscle and is distributed by 3-4 terminal ramuli to the dorsal portion of the muscle; caudad of the hiatus several (two shown in diagram) rami from the Accessorius enter the ental surface of the muscle.

Caudad of the hiatus (about 5 mm.) a large accession (Fig. Crv.) is received by the N. accessorius, from the cervical plexus. This nerve (myelic) accompanies the artery which appears in the hiatus.

The nerve trunk terminates upon the M. spino-trapezius. The tendon ectad of the *Delta mesoscapulae* marks the caudal border of the acromio-trapezius muscle and the cephalic border of the spino-trapezius; entad of the ventral angle of this tendinous fascia is found the caudal continuation of the N. accessorius, now designated as the spino-trapezius nerve.

N. spino-trapezius.—At the cephalic border of the M. spino-trapezius, the accessory nerve divides into dorsal and ventral rami which may be traced throughout the muscle. Since the muscle is innervated by the thoracic nerves (myelic) as well as by the terminal rami of the Accessorius, the terminal filaments of both nerves form an open plexus throughout its tissue.

SUMMARY.

A. ANATOMICAL.

Ectal Origin.—The N. accessorius arises from the lateral column of the cephalic myel and the caudal medulla dorsad of the area ovalis; the myelic roots are apparent as far caudad as the sixth or seventh cervical vertebra.

Entocranial Course.—The aggregation of these numerous roots forms a nerve-trunk which increases in volume from the caudal origin cephalad to the foramen of exit; the trunk is apposed to the lateral column of the myel, lies entad of the dura between the dorsal and the ventral roots of the myelic nerves, enters the cranium through the foramen magnum and extends cephalad in the cranium to the caudal roots of the N. vagus, where it perforates the dura and is associated with the vagus and the glosso-pharyngeus nerves in the foramen of exit.

Foramen of Exit.—The N. accessorius traverses the foramen jugulare with the associated vagus and accessorius nerves, the jugular vein and a small arteriole, a ramulus from the A. occipitalis.

Communicating Rami.

1. Accession to the G. jugulare (Vagus) centrad of the foramen of exit.
2. Several rami to the Plexus gangliformis, 5-10 mm. peripherad of the foramen jugulare (the first of these is the probable accession to the N. glosso-pharyngeus).
3. Accession to the G. inferius (Vagus).
4. With cervical nerves.

Principal Rami—their Ectal Origins and Distributions.*N. clavo-mastoideus.*

1. *Caudal ramus*; origin at the ental surface of the M. clavo-mastoideus as the nerve perforates the muscle.
2. *Cephalic ramus*; origin opposite the dorsal border of the muscle. These rami are distributed to the caudal and the cephalic portions of the muscle respectively.

N. sterno-mastoideus.

1. *Dorsi-cephalic ramus*; origin at the ectal surface of the M. clavo-mastoideus, distribution to the cephalic third of the muscle.
2. *Ventral ramus*; origin in common with the preceding, distribution to the thick ventral two-thirds of the muscle.
3. *Dorsi-caudal ramus*; origin at the dorsal border of the M. sterno-mastoideus in connection with the cephalic clavo-trapezius nerve, distribution to the thin dorsal border of the caudal two-thirds of the muscle.

N. clavo-trapezius.

1. *Cephalic ramus*; origin in common with the dorsi-caudal ramus of the sterno-mastoid nerve, distribution to the cephalic fourth of the M. clavo-trapezius; this nerve joins its platetrope in the dorsi-meson.
2. *Caudal ramus*; origin about the middle of the M. clavo-trapezius, distribution by 3-4 palmate ramuli to the ental surface of the caudal portion of the muscle.

N. acromio-trapezius.

1. *Cephalic ramus*; origin in the Hiatus trapezii, distribution to the cephalic portion of the acromio-trapezius muscle; this is the large nerve and extends to the dorsi-meson.
2. *Other rami*; several (two prominent) other rami supply the caudal portion of the muscle.

N. spino-trapezius.

The terminal rami of the Accessorius unite with the thoracic myelic nerves in an open plexus to the M. spino-trapezius.

Myelic Accessions.

Two large accessions from the myelic nerves are received by the trunk of the Accessorius, the *cephalic* is just caudad of the cephalic clavo-trapezius nerve, the *caudal* is just caudad of the hiatus-trapezii.

B. PHYSIOLOGICAL.

The N. accessorius is the motor nerve of the sterno-mastoid, the clavo-mastoid, and the trapezius muscles; it is possibly the source of the motor fibre of the Vagus nerve; it seems to be exclusively motor; its distribution and physiological experiments indicate the absence of sensibility; it is antagonistic to movements of respiration (Cl. Bernard); it controls laryngeal phonation (Cl. Bernard); it is cardio-inhibitory (Heidenhain).

EXPLANATION OF DIAGRAM.

The diagram seeks to present the principal rami and relations of the nerve. Actual measurements and perspective are sacrificed to clearness

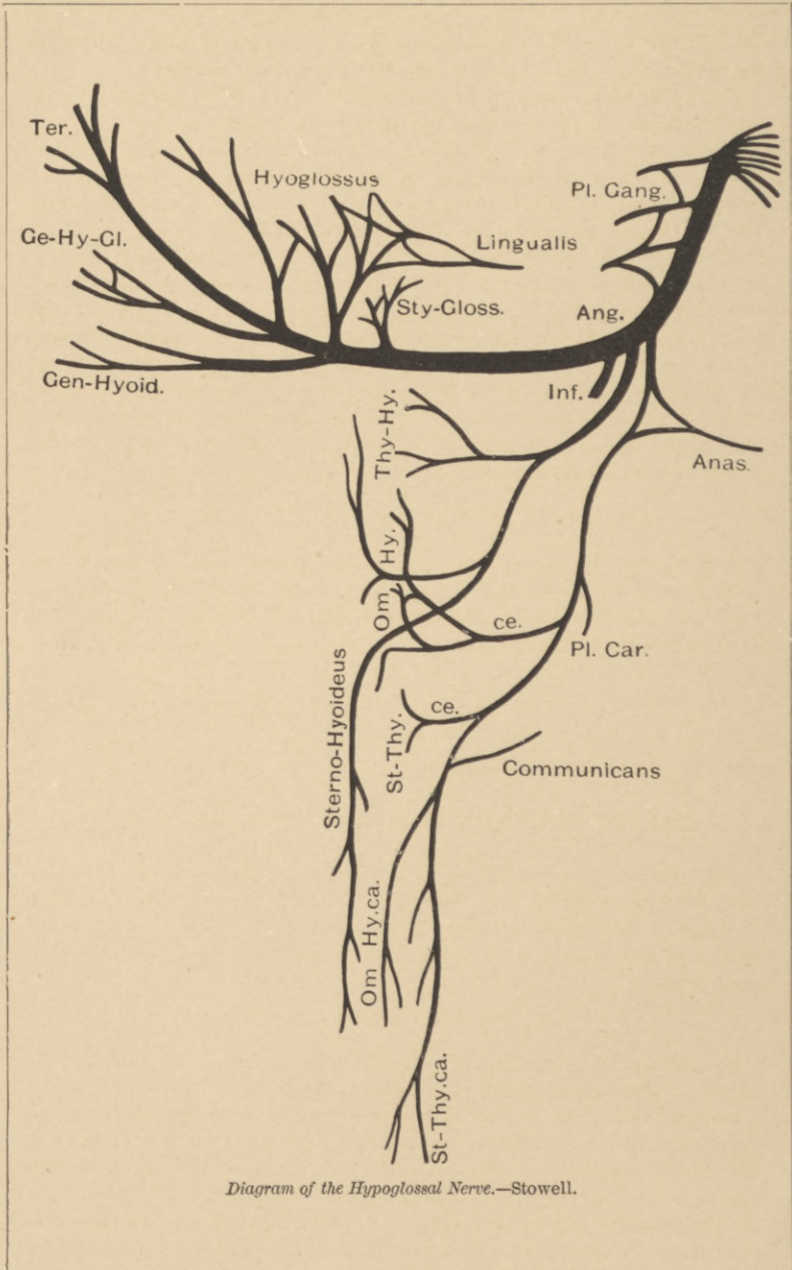


Diagram of the Hypoglossal Nerve.—Stowell.

and simplicity, *e.g.*, the dorsal rami are laterad and the terminal filaments are dorsad of the line of origin, which relation is not shown.

Acc. Accessions from the N. accessorius to the N. vagus, etc. Acromio-trapezius, the three rami to the M. acromio-trapezius.

Clavo-mastoideus, ca., the caudal ramus of the clavo-mastoid nerve. Clv.-mas. ce., the cephalic ramus of the same. Clavo-trapezius, the two principal rami to the M. clavo-trapezius. Crv., cervical myelic nerve. Hi, the hiatus trapezii. Inf, the ganglion inferius, or ganglion of the trunk of the N. vagus. Jug., the G. jugulare of the same nerve. Plexus, the gangliform plexus of the Glosso-pharyngeus, the Vagus, the Accessorius, the Hypoglossus, and the Sympathic nerves. Pl. Crv., the cervical plexus from which the accession is given to the N. accessorius near the hiatus. Spino-trapezius, the rami given to the M. spino-trapezius. Spl., the branch to the M. splenius. Ster.-mas., ramus to the cephalic extremity of the M. sterno-mastoideus. Ster.-mas. ce., ramus to the same. Ster.-mas., dors., ramus to the dorsal border. Ster.-mas., ven., ramus to the ventral border of the same muscle.

BIBLIOGRAPHY.

For bibliography consult the Trigemini Nerve in the Domestic Cat. T. B. Stowell. Proceedings of the American Philosophical Society, Vol. xxiii, pp. 459-478, 1886. Also, The Facial Nerve in the Domestic Cat. T. B. Stowell. Proceedings of the American Philosophical Society, Nov. 5, 1886.

The Hypoglossal Nerve in the Domestic Cat. By T. B. Stowell, A.M., Ph.D.

(Read before the American Philosophical Society, March 2, 1888.)

The reasons for presenting this contribution to comparative neurology have been given elsewhere. (The Facial Nerve in the Domestic Cat. Proceedings of the American Philosophical Society, Nov., 1886.) The preparation of specimens and the magnifying powers used are described in the same paper.

NERVUS HYPOGLOSSUS.

Synonymy.—N. hypoglossus; N. lingualis medius; Par nonum; N. loquens; Hypoglossal nerve; Gustatory nerve; Ninth pair of nerves.

General Characters.—The N. hypoglossus is the motor nerve of the tongue and of muscles that move the hyoid bone. By virtue of its relation to the tongue it is directly concerned in mastication, since by the movements of the tongue successive morsels of food are thrust between the teeth or are moved preliminary to deglutition. Its function is further shown by those mammals whose food is largely liquid and is secured

by lapping, in which animals the prehension of food is impossible after section of the N. hypoglossus. Longet's experiments upon the entocranial trunk after section demonstrated the presence of excitability without sensibility; Mayo and Magendie proved the presence of sensibility in the ectocranial nerve. We are forced to accept a mixed function in this nerve or to attribute its sensibility to the accessions from the myelic nerves.

The section of the N. hypoglossus destroys movements of the tongue without disturbing the tactile or the gustatory sensibility [Longet, *Anatomie et Physiologie du Système Nerveux*, t. ii, p. 266].

The sensibility of the hypoglossus seems to be muscular rather than mucosal. Since the section of the N. vagus and the N. glosso-pharyngeus is attended by loss of sensibility over the entire surface or dorsum of the tongue, although the N. hypoglossus is intact. Panizza's experiments, confirmed by later observations, establish the paralysis of the pharyngeal muscles involved in deglutition by severing the N. hypoglossus. The vaso-motor function of the N. hypoglossus is seen in the dilatation of the vessels of the tongue when the nerve is severed; it is questionable whether the fibres to which this function is referable are not received from the myelic or the sympathetic nerves.

The connection of the N. hypoglossus with distinct articulation is demonstrated by experiment and confirmed by pathological evidence. The prominent role in pronunciation performed by the tongue evinces the importance of this nerve in expressing thought by articulate language.

DESCRIPTION.

Ectal Origin and Entocranial Relations.—The N. hypoglossus has its ectal origin by several (12–16) funiculi along a depression line about 4 mm. laterad of the ventri-meson, and which marks the dorsal border of the caudal half of the area elliptica; these funiculi are grouped into two more or less distinct bundles which are separated by the first dorsal ramulus of the A. cerebellosa caudalis. The cephalic bundle embraces 8–12 funiculi (when the arteriole is represented by two vessels this cephalic bundle is again divided into two nearly equal portions); the caudal bundle includes about 6 funiculi, the caudal funiculus having its ectal origin at the cephalic border of the ventral root of the first cervical nerve, just entad of the A. cerebellosa.

The ectal origin resembles the ventral root of a myelic nerve.

Foramen of Exit.—The confluence of these funiculi forms a nerve trunk, which takes its exit by the foramen condylare.

Ectocranial Trunk.—The ectocranial course is immediately caudad, lies dorsad of the A. carotidea and entad of the V. jugularis as far as the A. occipitalis. The central 5–8 mm. of the ectocranial trunk are intimately involved in the gangliform plexus (Fig. Pl. gang.) which is made by the interlacing fibres of the associated glosso-pharyngeus, vagus, acces-

sorius, hypoglossus and sympathetic nerves. Peripherad of the plexus the N. hypoglossus bends abruptly around the caudal border of the A. occipitalis (Fig. Ang.) and crosses the ectal surface of the N. vagus just cephalad of the G. inferius (vagus), also crosses the ectal surface of the A. carotidea and lies upon the ectal surface of the A. lingualis, which it crosses twice (the artery being the more sinuous), first about 8 mm. peripherad of the origin of the artery (A. lingualis), and again 10-12 mm. still peripherad. This portion of the trunk lies entad of the M. stylo-hyoideus, along the caudal border of the M. digastricus.

Communicating Rami of the Trunk.—At the angle (Fig. Ang.) a considerable accession is received from the first cervical nerve (myelic, Fig. Anas.); it is possible that this accession is the true origin of the cervico-hypoglossal nerve. (The minute anatomy of this region has not been satisfactorily determined.) Just cephalad of the G. inferius, and peripherad of the plexus a large ramus (Fig. Inf.) joins the ganglion at its dorso-cephalic border.

PRINCIPAL RAMI.

N. cervico-hypoglossus; N. cervicalis descendens; N. descendens noni.—At the angle (Fig. Ang.) where the accession is received from the myelic nerves, as the hypoglossus curves around the A. occipitalis, the N. cervico-hypoglossus takes its ectal origin. An anastomotic nerve joins the myelic nerve and this trunk (Fig. Anas.). The existence of this anastomosis makes it debatable whether the cervico-hypoglossus should be considered a ramus of the N. hypoglossus having a myelic accession, or a myelic nerve having a large accession from the N. hypoglossus. I have adopted the compound name applicable to either of the views cited.

The course of the nerve is ventro-caudad, and is at first entad of the jugular vein; it reaches the carotid artery about 7 mm. caudad of the A. occipitalis and continues caudad upon the ectal surface of the artery about 12 mm. to the origin of the A. thyroidea.

N. omo-hyoideus.—At the origin of the A. thyroidea, a large ramus is given off ventrad (Fig. Om-Hy. ce.). This ramus lies ectad of the artery and innerves the cephalic 25 mm. of the M. omo-hyoideus. The caudal portion of the muscle is innerved by a ramus of the N. cervico-hypoglossus which takes its ectal origin at the point where the nerve trunk touches the dorsal border of the M. sterno-thyroideus. This slender caudal ramus crosses the ectal surface of the sterno-thyroid muscle, enters its dorsal border and may be traced within the muscle to the præsternum* (Fig. Om-Hy. ca.).

N. sterno-thyroideus.—Caudad of the A. thyroidea the cervico-hypoglossus lies in the ental cervical fascia, ectad and ventrad of the A. carotidea.

* The origin of the M. omo-hyoideus is costal instead of scapular, as is the case in man; the general relations are such that little doubt can exist as to the homology of the muscle.

At a point opposite the cephalic extremity of the thyroid body, the nerve-trunk sends a slender ramus, the *cephalic* sterno-thyroid (Fig. St.-Thy. ce), to the cephalic third of the M. sterno-thyroideus: the *caudal* ramus (Fig. St.-Thy. ca.) is the caudal 50-60 mm. of the N. cervico-hypoglossus, and may be said to have its ectal origin at the origin of the ramus to the caudal portion of the M. omo-hyoideus or at the point where the nerve trunk lies upon the dorsal border of the sterno-thyroid muscle; it follows the border of the muscle for about 20-30 mm., when it penetrates the muscle and terminates within the caudal extremities (origins) of the muscles (sterno-hyoid, omo-hyoid, sterno-thyroid), which have a common origin from the lateral border of the præsternum and the first costal cartilage.

Opposite the caudal extremity of the thyroid body the cervico-hypoglossal nerve is joined by a communicating ramus (Fig. communicans) from the adjacent cervical plexus or loop. This is the N. communicans noni. This branch does not seem to be constant.

N. thyro-hyoideus.—The ectal origin of this ramus is entad of the V. jugularis, immediately peripherad of the origin of the cervico-hypoglossal nerve; its course is parallel to the latter nerve and ventrad of it; it crosses the ectal surface of the A. carotidea at the origin of the A. laryngea cephalica, whence it bends ventrad and lies caudad of the artery and cephalad of the N. laryngeus internus; it innerves the M. thyro-hyoideus (Fig. Thy.-Hy.) and sends two terminal ramuli to the M. sterno-hyoideus, a *cephalic* ramulus to the cephalic portion, a *caudal* one to the caudal portion of the muscle. This nerve joins its platetrope in the ventri-meson.

N. stylo-glossus.—About 15 mm. ventrad of the A. carotidea the A. lingualis gives an arteriole to the M. stylo-glossus; centrad of this arteriole the hypoglossus nerve sends a branch, the N. stylo-glossus, to the muscle having the same name. The nerve lies upon the ectal surface of the M. hyo-glossus; at the ventral border of the stylo-glossus muscle it separates into a leash of terminal ramuli which intercommunicate by anastomotic filaments upon the muscle (Fig. Sty.-Gloss.).

N. hyo-glossus.—5 mm. peripherad of the last nerve the hyo-glossal nerve (sometimes 3-4 ramuli from a common trunk, or more frequently separate nerves) is given to the fibres of the M. hyo-glossus. The nerve crosses the ectal surface of the A. lingualis. The terminal filaments intercommunicate and form a loose plexus (Fig. hyoglossus) with the N. lingualis (R. of N. trigeminus), which in this region lies upon the ectal surface of the ranine artery.

N. genio-hyoideus.—At the dorsal border of the M. genio-hyoideus, the N. hypoglossus curves cephalad and follows the general direction of the genio-hyoid muscle, to which it gives from its ventral border the N. genio-hyoideus, which nerve may be traced 20 mm. cephalad in the muscle (Fig. Gen.-Hyoid).

N. genio-hyo-glossus.—Peripherad of the border of the M. genio-hyoideus, the N. hypoglossus bends mesad around the A. lingualis and lies entad of the artery. As it curves around the artery it gives from its ven-

tral border several filaments to the M. genio-hyo-glossus (Fig. Ge-hy-gl.); these filaments by their interlacing form a terminal plexus.

N. lingualis.—The hypoglossal nerve follows the artery along its ental border and supplies terminal filaments to distal 30 mm. of the tongue (Fig. Ter.).

SUMMARY.

A. ANATOMICAL.

Ectal Origin.—The nerve arises by 12–16 funiculi along a line 4 mm. laterad of the ventri-meson, which line marks the dorsal border of the caudal half of the area elliptica. The origin is nearly surrounded by arterioles from the A. cerebellosa.

Foramen of Exit.—Foramen condylare.

Principal Rami, their Origins and Distributions.

1. *N. cervico-hypo-glossus* (descendens noni); origin at the angle as the nerve bends around the A. occipitalis, distribution to the M. omo-hyoideus and to the M. sterno-thyroideus.

2. *N. thyro-hyoideus*; origin immediately peripherad of the last nerve, distribution to the M. thyro-hyoideus and to the M. sterno-hyoideus.

3. *N. stylo-glossus*; arises at a point 15 mm. ventrad of the A. carotidea, distribution to the M. stylo-glossus.

4. *N. hyo-glossus*; origin (2–3 rami) 5–10 mm. peripherad of the last nerve, distribution to the M. hyo-glossus; joins the N. lingualis in a plexus.

5. *N. genio-hyoideus*; origin at the dorsal border of the M. genio-hyoideus, to which muscle it is distributed.

6. *N. genio-hyo-glossus*; origin as the nerve trunk bends around the lingual artery.

7. *N. lingualis*; terminal filaments to the distal 30 mm. of the tongue.

Communicating Rami.

1. To the cervical sympathetic ganglion.

2. To the N. vagus in the plexus gangliformis and in the G. inferius.

3. A large accession at the *angle* from the first myelic nerve.

4. The communicans noni to the N. cervico-hypoglossus.

5. With the N. lingualis (R. of N. trigeminus) in the terminal plexus.

B. PHYSIOLOGICAL.

The N. hypoglossus is the motor nerve of the tongue; it innerves several muscles which move the os hyoides; it is directly related to mastication and to deglutition; it is essential to distinct articulation; in function it is possibly a mixed nerve, the sensibility however is referred by some physiologists to the accessions from the myelic nerves; it possesses vaso-motor fibres, which are possibly derived from the communicating rami.

EXPLANATION OF DIAGRAM.

Anas., anastomotic ramus from first myelic nerve ; this is the disputed origin of the N. cervico-hypoglossus. Ang., the angle where the N. hypoglossus bends around the A. occipitalis. Ca., caudal ramus. Ce., cephalic ramus. Communicans, a myelic accession, the communicans noni. Crv., myelic nerves. Gen-Hyoid, the genio-hyoid muscle. Ge-Hy-Gl., the genio-hyo-glossal muscle. Hyoglossus, the hyo-glossal muscle. Inf., the ramus to the G. inferius of the N. vagus. Lingualis, the lingual nerve of the mandibular division of the N. trigeminus. Om-Hy., the M. omo-hyoideus. Pl. car., anastomotic filament to the carotid plexus. Pl. gang., the plexus gangliformis. Sty-Gloss., the stylo-glossus muscle. St-Thy., the M. sterno-thyroideus. Thy-Hy., the M. thyro-hyoideus.

