the ramus. Behind, from the styloid process of the os temporis, a second, the stylo-maxillary, passes to be inserted just above the angle.

The external lateral ligament is a short, somewhat triangular-shaped band of fibrous tissue, having origin from the zygoma; passing obliquely downward and backward, and inserted about the neck of the condyle. Just below the head it lies in contact with the lateral aspect of the interarticular fibro-cartilage and assists in forming, or at least in thickening, the common capsule. Externally, it is quite superficial, being covered only by the integuments, except in instances where the upper border of the parotid gland spreads over it. The importance of the character of this articulation renders necessary its careful study by direct dissection.

CHAPTER III.

FIFTH PAIR OF NERVES.

Fig. 34.—Outline Drawing exhibiting at a Common View the Distribution of the Fifth Pair of Nerves.
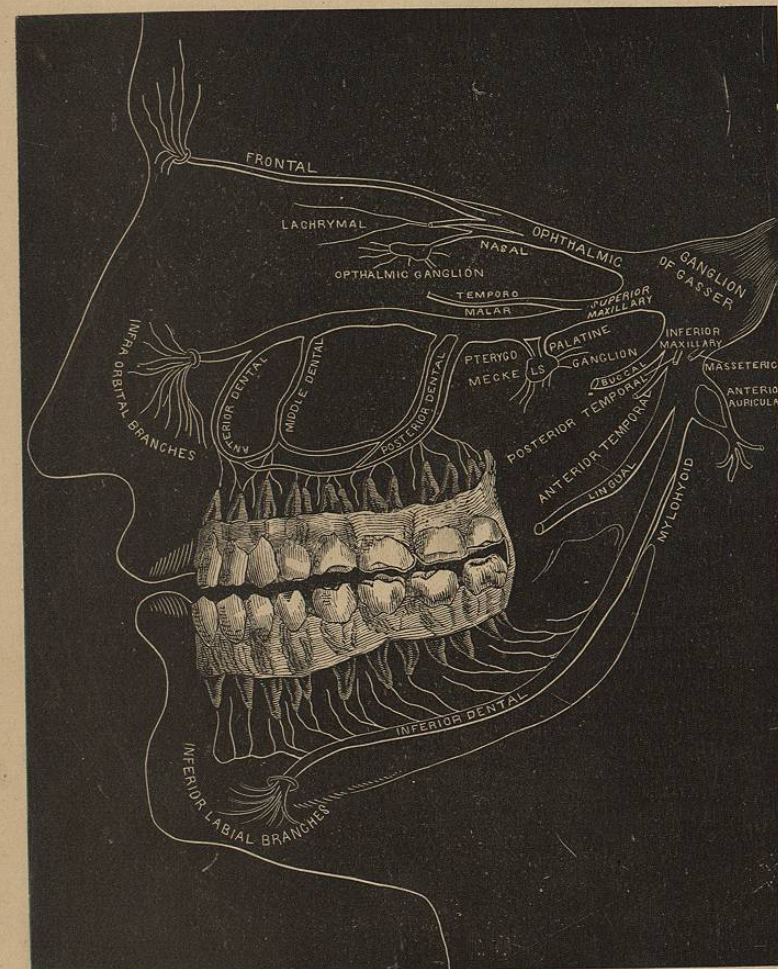

THE Fifth is an encephalic nerve,—that is, it comes off from that portion of the cerebro-spinal centre lying within the cranium. It is called the fifth,

because this is its order of emergence; also trifacial, because it divides into three portions, which portions, in their divisions and subdivisions, are distributed respectively to the superior, middle, and inferior portions of the facial region; also, "trigeminus," a name derived from *tri*, three, *geminus*, twin, or double, signifying literally three double, triple, referring to its threefold division. The fifth is the nerve with which oral surgery has most to do.

The fifth, trifacial, or trigeminus, is first discovered as a number of filaments, of which there are two distinct sets, coming off from the sides of the

FIG. 35.—TRIFACIAL DIVISION AND GANGLION.
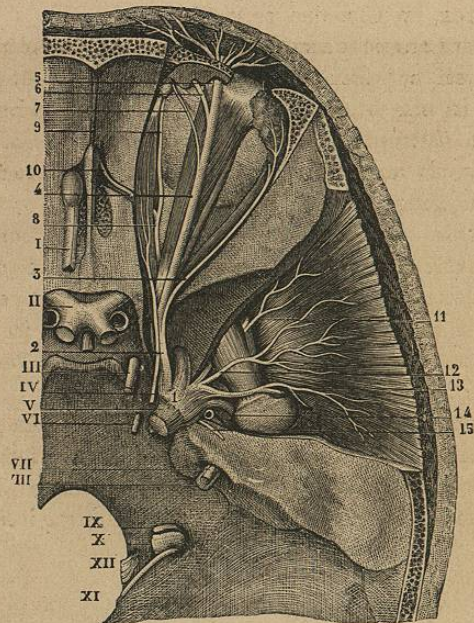
TRIFACIAL NERVE, the upper part of the orbit and temporal fossa removed. 1, semilunar ganglion; 2, ophthalmic nerve; 3, lachrymal nerve; 4, frontal nerve; 5, 6, its two principal branches; 7, a branch passing from the orbital above the pulley of the superior oblique muscle; 8, nasal nerve; 9, its external nasal branch; 10, course of the internal nasal nerve from the orbit into the cranium and nose; 11, 12, 13, temporal branches of the inferior maxillary nerve; 14, commencement of the auriculo-temporal nerve; 15, greater petrosal nerve. I, olfactory nerve; II, optic nerves; III, oculo-motor nerve; IV, pathetic nerve to the superior oblique muscle of the eye; V, trifacial nerve; its small root visible beneath the cut end of the large root, which forms the semilunar ganglion dividing into the ophthalmic, superior, and inferior maxillary nerves; VI, abducent nerve; VII, facial, included in a groove of the auditory nerve, VIII, both entering the auditory meatus; IX, glosso-pharyngeal, X, pneumogastric, and XI, accessory nerves emerging at the jugular foramen; XII, hypoglossal nerve.

pons Varolii; this is called the superficial origin of the nerve. The deep, or true origin, is to be traced into the substance of the pons as far as the lateral tract of the medulla oblongata. These filaments of origin are called the roots of the nerve, and, being twofold, afford the likeness which exists between this particular encephalic nerve and those of the spinal cord.

The fifth nerve is peculiar in being both compound and special: that is to say, it supplies parts with filaments of sensation, with filaments of motion, and through one of its branches, the "gustatory," with filaments which pertain to the sense of taste. It is the great sensitive nerve of the head and face; the nerve of motion to the muscles of mastication; a nerve of special sense to the anterior part of the tongue. (See *Function of Nerve*.)

Immediately on the emergence of the roots from the points of their superficial origin, they pass through a slit-like opening in the dura mater at the apex of the petrous portion of the temporal bone. Here the larger root, called the sensor, enters a ganglion, lying in a fossa on the anterior face of this triangular apex, the Casserian, or semilunar.

The ganglion of Casserio is a small reddish-gray semilunar knot enveloping apparently the great, or posterior, root of the fifth nerve as it passes over the temporal apex; its size is about equal to that of an ordinary buckshot, although, from its flattened and crescentic form, the measurement from tip to tip of its horns would surpass somewhat the diameter of such a shot. The convex face of the ganglion looks forward.

On emerging from this ganglion, the posterior root is found divided into three cords,—the three primary divisions of the sensitive portion. The first of these cords constitutes what is called the ophthalmic nerve, or the ophthalmic portion, or division, of the fifth nerve. The second cord is the superior maxillary nerve, or superior maxillary division of the fifth. The third is the inferior maxillary nerve.

The first of these nerves has its distribution over the orbito-frontal region.

The second is distributed over the superior maxillary region.

The third associates with the lesser, or motor root, which root first connects with it at the base of the skull, and finds its office in the inferior maxillary region.

OPHTHALMIC NERVE.

This division of the fifth passes from the Casserian ganglion along the outer wall of the cavernous sinus, and enters the orbit through the sphenoidal fissure; before entering this, however, it breaks up into three branches. These branches supply the eyeball, the lachrymal gland, the mucous lining of the nose, and the muscles and the integument of the forehead; they are named frontal, lachrymal, nasal. The ophthalmic is the smallest of the three divisions of the fifth; it is a flattened band not more than an inch in length, receiving, before breaking up into its terminal branches, filaments from the carotid plexus of the sympathetic, and giving off itself two or more filaments, which, with a branch from the fourth nerve, pass between the layers of the tentorium.

The *Frontal Branch* is the largest of the divisions of the ophthalmic, and is commonly regarded as the continuation of the nerve. In the orbit it lies above the levator palpebræ muscle, between it and the periosteum;

dividing about midway of the cavity into two branches,—supratrochlear and supraorbital.

The supratrochlear branch passes inward to the pulley of the superior oblique muscle, giving off here descending filaments which anastomose with similar trochlear filaments from the nasal nerve. A second or terminal branch passes from the orbit between the superior oblique and supraorbital foramen, ascends behind the corrugator supercilii and occipito-frontalis muscles, to both of which it distributes filaments, and is finally lost in the integument of the forehead.

The supraorbital branch, or division, of the frontal runs forward until it reaches the supraorbital foramen, when it passes out upon the forehead. In this situation it gives off a number of filaments to the upper eyelid, called palpebral. In its distribution over the forehead, it sends branches to the orbicularis palpebrarum, occipito-frontalis, and corrugator supercilii muscles, anastomosing in the first-named muscle with filaments of the facial nerve. Other two sets of terminal filaments supply: the first, the periosteum covering the frontal and parietal bones; the second, the integument, as far back as the occiput.

The *Lachrymal.*—This is the smallest of the three divisions of the ophthalmic. It is almost always accompanied by filaments from the fourth nerve. In the eye cavity it connects itself with the orbital branch of the second, or superior maxillary division of the fifth nerve. Its distribution is to the lachrymal gland, the conjunctiva, and the integument of the upper eyelid, in which last situation it joins with filaments of the facial nerve.

The *Nasal.*—This division is intermediate in size between the frontal and lachrymal. Entering the cavity of the orbit between the two heads of the external rectus, it passes directly across the optic nerve to the anterior of the ethmoidal foramina; through this foramen it passes into the cavity of the cranium, where it traverses the shallow groove on the front of the cribriform plate of the ethmoidal bone, until arriving at the nasal slit it passes directly downward into the nose, terminating in two branches. Of these two branches, the external descends on the inner surface of the nasal bone, supplying the mucous membrane of its neighborhood; leaving the cavity at the juncture of the bone with the lateral cartilage, it passes, on the external part of the nose, to supply the integument of the lips, and join with the facial nerve. The second branch, the internal, supplies the mucous membrane about the front of the septum.

In the orbital cavity three branches are given off by the nasal,—the ganglionic, ciliary, and infratrochlear.

The ganglionic is a slender cord, about half an inch in length, which is the sensor filament to the orbital, or ophthalmic, ganglion. (See *Ganglia.*)

The ciliary separates into branchlets, called long ciliary, to distinguish them from certain shorter branches, called also ciliary, given off from the ophthalmic ganglion. These branches are two or three in number; in asso-

ciation with the short ciliary they pierce the posterior face of the sclerotic, and, passing between this coat and the choroid, are distributed to the ciliary muscle and iris.

The infratrochlear branch is given off just as the main portion passes into the ethmoid foramen, joining, beneath the pulley of the superior oblique muscle, with a filament of the supratrochlear nerve; this branch continues to the inner angle of the orbit, where it is distributed to the orbicular muscle, the integument of the eyelid, and side of the nose, to the conjunctiva caruncula lachrymalis and lachrymal sac.

Recapitulation.—The ophthalmic, or first, division of the fifth nerve supplies the tentorium, lachrymal gland, caruncula lachrymalis, lachrymal sac, ciliary muscle and iris, muscles of eyelid and forehead, integument of forehead and nose, mucous membrane of eye and nose, and pericranium of frontal and parietal regions.

SUPERIOR MAXILLARY NERVE.

This nerve, or division, arises, as a flattened band, from the middle of the Casserian ganglion. It passes forward over the greater wing of the sphenoid bone, until, reaching the foramen rotundum, it leaves the cranium, and presents itself in the spheno-maxillary fossa; from this fossa it passes to the orbital cavity, through the spheno-maxillary fissure, where, being lodged in the infraorbital canal, it continues forward to the points of its ultimate distribution.

BRANCHES OF DISTRIBUTION. — 1. *In the Spheno-maxillary Fossa.* Three,—the orbital, the ganglionic, the posterior dental.

The orbital enters, with the main branch of the nerve, the orbital cavity, and divides into two branches, temporal and malar. The temporal branch passes from the orbit through a foramen in the malar bone, and enters the temporal fossa; it here perforates the temporal muscle and fascia, and is distributed to the integument covering the side of the head, and associates, with the facial nerve, also with an ascending branch, auriculo-temporal, of the inferior maxillary. The malar branch leaves the orbit also through a foramen in the malar bone, perforates the orbicularis palpebrarum muscle, and joins with a branch of the facial.

The ganglionic divides into two branches, which drop directly down into the spheno-palatine, or Meckel's, ganglion; hence they are commonly known as the spheno-palatine branches.

The posterior dental arises from the trunk just as it enters the orbit; it immediately breaks up into an anterior and a posterior portion. The first supplies the gums and buccinator muscle; the second pierces the tuberosity of the maxillary bone, and, after forming a minute plexus above the alveolus, distributes filaments to each of the posterior teeth; its termination is lost in a union with the anterior dental nerve.

2. *In the Infraorbital Canal.*—One, the anterior dental. This branch

is given off about midway of the canal. It enters a second canal existing on the anterior face of the maxillary sinus, and curving backward, associates itself, as above alluded to, with the posterior dental; from the curve are given off filaments to the anterior teeth,—incisors, canines, and bicuspidati.

FIG. 36.—SUPERIOR MAXILLARY NERVE.
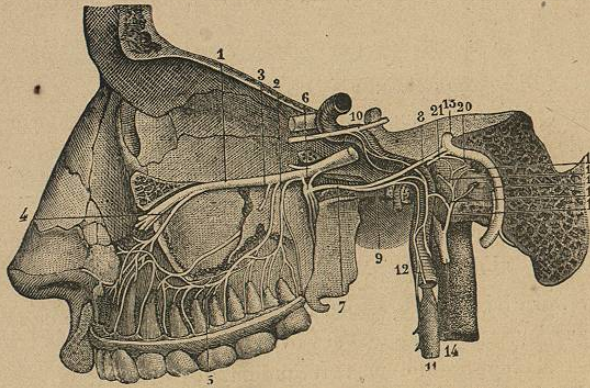
THE EXTERNAL WALL OF THE LEFT ORBIT AND OF THE SUPERIOR MAXILLARY BONE REMOVED. 1, superior maxillary nerve in its course through the infraorbital canal; 2, 3, posterior dental nerves; 4, anterior dental nerve; 5, anastomosis between the dental nerves; 6, spheno-palatine ganglion; the branch from the superior maxillary nerve above is the commencement of the temporo-malar nerve; 7, pterygoid nerve; 8, greater petrosal nerve joining the facial nerve; 9, deep petrosal nerve joining the carotid plexus of the sympathetic; 10, abducent nerve with its communicating branches of the latter plexus; 11, superior cervical ganglion; 12, ascending branches to the carotid plexus; 13, facial nerve; 14, glosso-pharyngeal nerve; 15, the tympanic nerve; 16, branch to the carotid plexus 17, 18, 19, branches to the round and oval windows and Eustachian tube; 20, branch to the smaller petrosal nerve, 21.

3. *On the Face.*—Three,—palpebral, nasal, labial. These are the terminal filaments, the division occurring as the nerve issues from the infraorbital foramen. The palpebral filaments ascend to supply the orbicularis palpebrarum muscle and the integument and conjunctiva of the lower eyelid; at the outer angle of the orbit they associate with the malar branch of the orbital and filaments of the facial nerve. The nasal filaments pass across the nose, supplying the muscles and integument of this region; they usually join at the tip with the nasal branch of the ophthalmic. The labial filaments pass downward beneath the levator labii superioris, and are distributed to the muscles and integument of the upper lip, to the mucous membrane of the mouth, and to the labial glands. The intricate plexus situated in the canine fossa is formed of filaments from the facial nerve associating with twigs of the trimaxillary division.

Recapitulation.—The superior maxillary nerve, or second division of the fifth, supplies the integument on the side of the head, Meckel's ganglion with its sensor filaments, the upper teeth, the antrum, orbicularis palpebrarum muscle, integument and conjunctiva of lower eyelid, muscle and integument

of nose, muscles, integument, and mucous membrane of superior lip, and labial glands.

INFERIOR MAXILLARY NERVE.

This nerve, or division, is the largest of the three, and constitutes, justly speaking, the only portion of the fifth nerve compound in character. The sensor portion is the third of the cords emerging from the Casserian ganglion:

FIG. 37.—INFERIOR MAXILLARY NERVE.
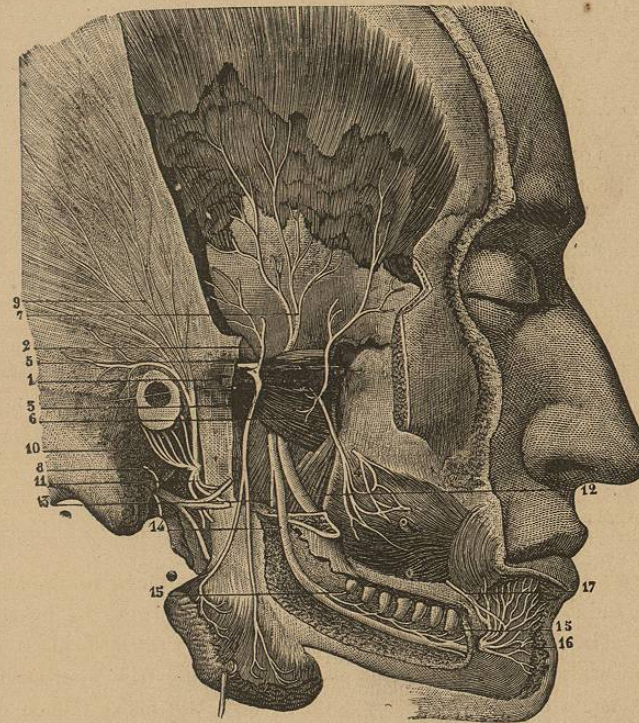
DISTRIBUTION OF THE INFERIOR MAXILLARY NERVE. 1, muscular branch to the masseter muscle; 2, 5, 7, branches to the temporal muscle; 3, branch to the buccinator, anastomosing with one from the facial at 4; 6, external pterygoid muscle; 8, auriculo-temporal nerve; 9, branches to the temple; 10, branches to the ear; 11, its anastomosis with the facial; 12, lingual nerve; 13, branch to the mylo-hyoid muscle from the inferior dental nerve, 14; 15, branches to the teeth; 16, terminal branches to the lower lip and chin.

the motor portion is that lesser root alluded to as coming off from the pons Varolii; the sensor cord falls quickly into the oval foramen of the sphenoid bone, through which it passes from the cranium. The motor cord, which has passed forward beneath the Casserian ganglion, unites with the sensor just as it emerges from this foramen. Here then is made, by this union, a single cord, the perfected, or compound inferior maxillary nerve,—a nerve made up of filaments of motion and filaments of sensation. At the point

of juncture of these two cords is found a little ganglion, the otic. (See *Ganglia*.)

Immediately beneath the base of the skull, this compound inferior maxillary nerve divides into two branches,—anterior and posterior. Into the anterior branch pass most of the motor filaments.

The anterior branch breaks up into five divisions, and is distributed to the muscles of mastication. These divisions, or branches, receive names from the parts supplied by them; they are the masseteric, buccal, deep temporal, and pterygoid.

The posterior branch is the larger of the two divisions: it subdivides into three parts. These supply the inferior teeth, tongue, and auriculo-temporal region. Hence the branches are named inferior dental, lingual, and auriculo-temporal.

DIVISIONS OF ANTERIOR BRANCH.—*Masseteric.*—This branch runs across the sigmoid notch of the inferior maxillary bone, enters the substance of the masseter muscle, and is distributed in it. In crossing the notch it occasionally gives off a filament to the articulation.

Deep Temporal Branches.—These are two in number. They pass under the temporal muscle, and supply its deep surface.

Buccal.—This branch pierces the external pterygoid muscle, passes beneath the coronoid process of the jaw, pierces the fibres of the temporal muscle, and, reaching the buccinator, divides upon it into a superior and inferior branch. The superior supplies the upper part of the muscle and the integument; the inferior, the lower part of the muscle and its lining mucous membrane.

Pterygoid Branches.—Two in number,—one supplying each pterygoid muscle.

DIVISIONS OF POSTERIOR BRANCH.—*Auriculo-Temporal.*—This branch passes out to the inner side of the temporo-maxillary articulation, turns upward in company with the temporal artery, and, on emerging with this vessel from beneath the parotid gland, divides into two branches. The posterior of the two supplies the attrahens auriculæ, the pinna, and the neighboring integument. The anterior passes upward with the terminal branches of the artery, and is distributed to the temporal integument. Branches of communication exist between the auriculo-temporal nerve, the facial, and the otic ganglion. The articulation, the parotid gland, and the external auditory meatus receive nerve endowment from the auriculo-temporal.

Lingual, or Gustatory.—This branch is a nerve of special sense, presiding in part over the function of taste; its terminal filaments, as might be inferred, are distributed extensively to the papillæ and mucous membrane of the tongue. Of the three sets of papillæ, the filiform and fungiform, or those situated on the anterior two-thirds of the organ, receive the principal supply, the posterior, or great papillæ, being endowed from the glosso-pharyngeal. On this account it was deduced that the gustatory presided over taste only as

the anterior two-thirds of the tongue was concerned; and this inference has been abundantly borne out by vivisection. (See Todd and Bowman's Physiology, pages 385 to 390.) In the dissection, the gustatory branch is seen coming off just opposite the sigmoid notch. In company with the inferior dental nerve, or branch, it passes down along the inner side of the ramus, until, leaving the dental somewhat above the posterior dental foramen, it crosses obliquely to the side of the tongue, along which it pursues its way to its points of final termination, anastomosing at the tip of the organ with filaments of the hypoglossal. In its course it lies first beneath the external pterygoid muscle, crosses the internal pterygoid, rests upon the superior constrictor of the pharynx, and passes over Wharton's duct, where it reaches the apex of the tongue. In its course, branches of communication are given off to the submaxillary ganglion and the hypoglossal nerve.

Inferior Dental Nerve, or Branch.—This is the largest of the three divisions of the inferior maxillary nerve. Between its point of origin and entrance into the dental canal, it gives off a branch, the mylo-hyoid, distributed to the mylo-hyoid and anterior belly of the digastric muscles. The main portion, after entering the posterior foramen of the dental canal, pursues its way beneath the teeth, giving, in its course, filaments to all these organs, terminating finally in a branch, the mental, which passes from the canal at the mental foramen, and has its distribution in the muscular and cutaneous substance of the inferior lip.

Recapitulation.—The inferior maxillary nerve, or third division of the fifth, supplies the muscles of mastication, the auriculo-temporal region, the anterior two-thirds of the tongue, the mylo-hyoid and digastric muscles, the inferior teeth, and the muscles and skin of the lower lip.

## GANGLIA OF THE FIFTH PAIR OF NERVES.

Associated with the fifth nerve are six ganglia: they are called Casserian; ophthalmic, lenticular, or ciliary; Meckel's, or spheno-palatine; naso-palatine, or ganglion of Cloquet; otic; submaxillary.

Ganglion of Casserio.—This ganglion, called as frequently the semilunar, from its shape, is found lying in a slight depression on the anterior face, near the apex of the petrous portion of the temporal bone. It receives the posterior or sensor cord of the fifth nerve, and transmits it divided into three parts. The ganglion receives filaments from the carotid plexus of the sympathetic, and gives off filaments to the tentorium cerebelli, and to the dura mater of the middle fossa of the cranium.

Ophthalmic, Lenticular, or Ciliary Ganglion.—This ganglion, as implied in its name, is found in the cavity of the orbit. It is a small, quadrangular, flattened body, not larger, generally, than the ordinary pin-head. It is situated between the external rectus muscle and optic nerve, well enveloped in the mass of fat found occupying this portion of the cavity. Its branches of communication are derived, the first, or sensor, from the nasal; the second, or

motor, from the third nerve; the third, or sympathetic, from the cavernous plexus. Its branches of distribution are the short ciliary nerves. These nerves, ten or twelve in number, arise from the anterior face of the ganglion, being

FIG. 38.—OPHTHALMIC GANGLION—THE OUTER PART OF THE RIGHT ORBIT REMOVED.
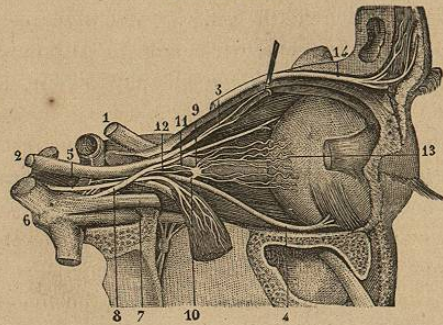
1, optic nerve; 2, oculo-motor nerve; 3, branch to the superior straight and oblique muscles; 4, branch to the inferior oblique muscle; 5, abducent nerve to the external straight muscle; 6, trifacial nerve, its ganglion and three principal branches; 7, ophthalmic nerve; 8, nasal nerve; 9, ophthalmic ganglion; 10, its communicating branch with the oculo-motor nerve; 11, do. with the ophthalmic nerve; 12, do. with the carotid plexus of the sympathetic; 13, the ciliary nerves; 14, frontal nerve.

FIG. 39.—VIEW OF THE SPHENO-PALATINE GANGLION AND OF THE OUTER WALL OF THE LEFT NASAL CAVITY, AND THE OLFACTORY NERVE.
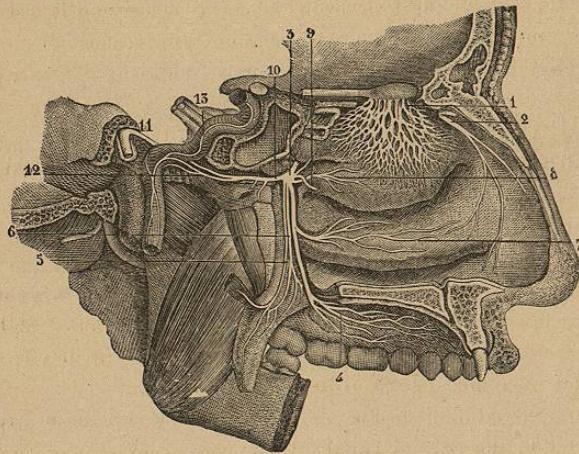
1, olfactory nerve; 2, nasal branch of the ophthalmic nerve; 3, spheno-palatine ganglion; 4, 5, 6, palatine nerves; 7, branch to the nose; 8, nasal nerve to the outer wall of the nose; 9, do. to the inner wall; 10, pterygoid nerve; 11, facial nerve; 12, deep petrous nerve joining the carotid plexus; 13, the other branch of the pterygoid is the larger petrosal nerve, which joins the facial.

connected, as two sets of filaments, with the superior and inferior angles. The two sets pass forward, one being above, the other below the optic nerve,

until, reaching the sclerotic coat of the eye, they penetrate this organ, and are distributed to the ciliary muscle and iris.

Meckel's Ganglion—Spheno-Palatine.—This is the largest and most extensively connected of the cranial ganglia. Its position is in the spheno-maxillary fossa, immediately in front of the vidian foramen. In shape it is triangular, and in color reddish-gray. Its branches of communication are derived, the first, or sensor, from the superior maxillary nerve, which, as has been seen, gives to it two filaments while crossing the fossa. The second, or motor, is derived from the facial nerve, or rather from the intumescentia gangliformis of that nerve. This branch is known as the great petrosal nerve; it emerges from the Fallopian canal through the hiatus Fallopii, passes along the groove leading from this foramen, until, reaching the foramen lacerum basis cranii, it pierces the cartilaginous substance, filling up this osseous break, and entering the vidian canal, associated with the carotid nerve, passes forward, under the name of vidian, to the ganglion. The third, or sympathetic, is derived from the carotid plexus through the vidian.

The branches of distribution from this ganglion are numerous; they supply a portion of the orbital periosteum, the nares, the hard and soft palates, the half arches, the tonsil, the pharynx, etc.

The ascending branches, two or three in number, enter the orbit through the spheno-maxillary fissure; they supply the periosteum.

The descending, called palatine branches, are three in number; the anterior of these, or large palatine nerve, descends through the posterior palatine canal, passes along the groove on the hard palate, and is distributed to the gums, the mucous membrane, and palatine glands, anastomosing back of the incisor teeth with the naso-palatine nerve; while in the palatine canal, filaments are given off which pass to the middle and inferior turbinated bones.

The middle branch, called external palatine nerve, descends through the same canal as the preceding: it distributes its filaments to the soft palate, to the uvula, and the tonsil.

The posterior, called small palatine nerve, descends through the accessory palatine canal, and emerges back of the posterior palatine foramen. It is distributed to the levator palati muscle, to the soft palate, tonsil, and uvula.

Coming off from the internal surface are two sets of branches; these are called superior nasal and naso-palatine.

The superior nasal, four or five in number, enter the nasal fossa by the spheno-palatine foramen; they supply the mucous membrane of the superior portion of the fossa.

The naso-palatine enters the fossa with the other nasal nerves, runs across the roof of the nose, until, reaching the septum, it descends between the periosteum and mucous membrane to the anterior palatine foramen; passing through this canal, it unites with its fellow of the opposite side, and distributes its filaments to the mucous membrane about the incisive fossa.