oblongata. The sensory V. nucleus effects secondary connections with the motor cranial nuclei and with the higher centres via the lateral fillet of the same and the opposite side.

The three main branches of the trigeminus (which give the nerve its name) arise directly from the Gasserian ganglion. For the details of their distribution, see the

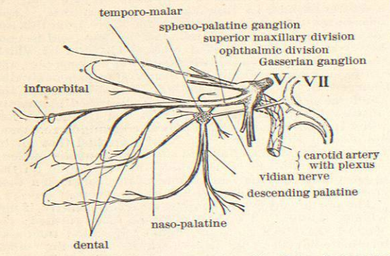

FIG. 1562.—Plan of the Maxillary Division of the Trigeminus as seen from the Left Side. (Altered from Young.)

figures. (1) The ophthalmic nerve is wholly sensory (Fig. 1561). It communicates with the sympathetic, III., IV., VI., and VII., nerves. Its first branch is a recurrent meningeal twig for the tentorium, after which it divides into nasal, frontal, and lachrymal branches. The nasal nerve furnishes the long root of the ciliary ganglion (a ganglion of the sympathetic system), the long ciliary nerves, twigs for the conjunctiva, lining of the nasal fossa, and skin of the tip of the nose. The frontal nerve supplies the conjunctiva and skin of the upper eyelid and the forehead. The lachrymal branch innervates the lachrymal gland, conjunctiva, and adjacent skin. (2) The maxillary nerve (Fig. 1562) is also wholly sensory, supplying the skin of the side of the face (cheek, temple, lower eyelid, nose, and upper lip), the mucous lining of the nose and upper part of the pharynx and the teeth of the upper jaw, and communicating with the sympathetic spheno-palatine ganglion. (3) The mandibular nerve (inferior maxillary) receives the remainder of the general cutaneous fibres and all of the motor fibres of the trigeminal roots. The motor fibres supply the following muscles: temporal, masseter, external and internal pterygoid, tensor palati, tensor tympani, mylohyoid, and the anterior belly of the digastric. The sensory fibres supply the skin of the lower jaw, side of the head, external ear, external auditory meatus, teeth of the lower jaw, tongue (general sensation only), mucous lining of the mouth and other parts adjacent. It communicates with the facialis and with the otic and submaxillary ganglia of the sympathetic system. The lingual branch is joined by the chorda tympani from the geniculate ganglion of the facial nerve, and there has been much discussion regarding the exact courses of the fibres of these two nerves. The weight of evidence is clearly in favor of relegating the gustatory fibres all to the chorda and excluding this component from the trigeminus entirely.

Summary of the Nerves of the Branchiomeric Type.—These nerves typically comprise the following branches, viz.: (1) dorsal general cutaneous branches for the outer skin; (2) sensory pharyngeal branches for the mucosa of the roof of the pharynx, of communis nature; (3) a pretrematic branch for the gill on the anterior side of the corresponding gill cleft and its contained sensory organs, wholly sensory (communis); (4) a post-trematic branch for the gill on the posterior side of the cleft and its contained sense organs, together with the branchial musculature of that segment (communis and viscero-motor).

With the loss of the gills in higher vertebrates, this relation is obscured, the vagus preserving the dorsal cutaneous branch and the IX. and X. retaining the communis and motor roots with great modifications in their peripheral relations. The VII. pair is more nearly typical, having lost the cutaneous component, reduced the communis, and enlarged the motor. The V. pair is the most highly modified of all, having lost the communis element and enormously exaggerated the cutaneous, the motor remaining typical. In all vertebrates except the very lowest the centres within the oblongata for these systems are not repeated in serial metameric order for the successive pairs of nerves, as tends to be the case in the spinal nerves, but each system has been concentrated centrally and unified by the coalescence of all of the terminal nuclei into a single centre, independently of the roots by which these fibres may reach the periphery. This is more obvious in the case of the sensory fibres than the motor, whose nuclei of origin are for the most part distinct. Thus, the communis fibres (visceral and gustatory) enter the brain by the X., IX., and VII., roots, but all terminate in a single nucleus associated with the fasciculus solitarius. This admits of the unification of their cortical and other secondary connections. This applies also in the case of the fishes, where the taste buds are much more widely distributed in the pharyngeal cavity and even over extensive areas of the outer skin. In the same way the general cutaneous fibres, whether they enter by the V., the IX., or the X. root, all terminate in the gray matter associated with the spinal V. tract, the substantia gelatinosa, and the chief sensory nucleus of the trigeminus. The primary connections of the branchiomeric nerves of man are shown in the accompanying diagram (Fig. 1564).

THE EYE-MUSCLE NERVES.—These nerves (including the III., IV., and VI. pairs in all vertebrates) are commonly regarded as arising from a cephalic continuation of the ventral horns. The evidence for this is chiefly embryological. The muscles innervated are derived from the somites of the head, and are the only cranial muscles of the adult known to be so derived, save those which have migrated forward from the hypoglossus

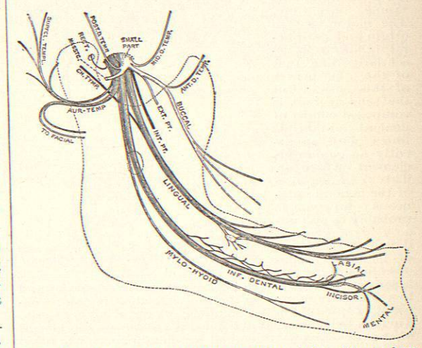

FIG. 1563.—Plan of the Mandibular Nerve. (After Thane, from Quain's "Anatomy.")

region. Their nuclei of origin lie in the floor of the ventricle and far removed from other somatic motor nuclei.

VI. Abducens.—This is the simplest of the eye-muscle nerves. Its nucleus lies in the floor of the fourth ventricle, enclosed by the genu of the facialis, and its fibres pass out on the ventral surface of the brain just behind

the pons. It pursues a direct course to the m. rectus externus, receiving minute filaments from the carotid plexus of the sympathetic and from the ophthalmic branch of the trigeminus. The connections of its nucleus are: (1) by collaterals from the sensory cranial

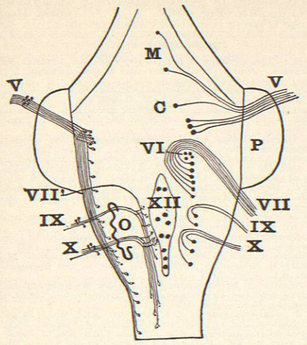

FIG. 1564.—A Diagram of the Primary Connections of the Nerves of the Branchiomeric Type of Man (including the Nuclei of Origin of the VI. and XII. Nerves). (Combined from Obersteiner and other sources.) The motor roots are entered on the right side of the figure, the sensory roots on the left. The diagram shows the serial arrangement of the motor nuclei and the unification of the sensory fibres in connection with the fasciculus solitarius (VII., IX., and X. nerves) and the spinal V. tract (V., IX., and X. nerves). Compare FIG. 1553 and also the arrangement in the fish, FIG. 1535. *C*, the locus ceruleus; *M*, the mesencephalic nucleus of the trigeminus; *O*, the olive; *P*, the pons Varolii.

nerve roots (especially the trigeminus), (2) from the cerebral motor paths, (3) from the superior olive, (4) from the fasciculus longitudinalis, connecting with the pregeminum, or superior member of the corpora quadrigemina.

IV. Trochlearis.—The nucleus of the IV. nerve lies in the floor of the aqueduct just caudad of that of the III. nerve. The fibres curve outward, dorsally and backward to emerge from the brain above the aqueduct and behind the postgeminum, there to decussate completely in the valve of Vieussens, thence to run forward to supply the superior oblique muscle. It is joined by filaments from the sympathetic and from the ophthalmic branch of the trigeminus.

III. Oculomotorius.—The fibres of the third nerve arise chiefly from a collection of nuclei in the floor of the aqueduct under the pregeminum. They pass directly ventrally in about twelve bundles which emerge on the inner face of the crus cerebri near the median line and distribute to four of the six extrinsic muscles of the eyeball, to the levator palpebræ and through the ciliary ganglion to the intrinsic muscles of accommodation. This nerve receives a twig from the cavernous plexus of the sympathetic and another from the ophthalmic branch of the trigeminus. The details of its peripheral courses may be gathered from the accompanying figures and their descriptions (Figs. 1565 and 1561).

The Nuclei and Central Connections of the Eye-Muscle Nerves.—The nuclei of the III. and IV. nerves comprise a very complex aggregate of cells lying in the floor of the aqueduct from the region of the upper (cephalic) end of the postgeminum to the III. ventricle. The lowest cluster gives rise to the IV. nerve. Regarding the details of the disposition of the fibres from the other clusters, there is still great diversity of opinion. Aside from the principal oculomotor nucleus (which Perlia subdivides into four nuclei), there is an unpaired median nucleus of large cells which seems to be related to the intrinsic muscles of the eyeball. Laterally of this there is on each side a nucleus of small cells, the nucleus of Edinger-Westphal; farther cephalad and near the median line, the "antero-median" nucleus; and laterally and dorsally of this the nucleus of Darkschewitsch. The three last mentioned probably (and quite certainly in the case of the nucleus of Darkschewitsch) have nothing to do with the oculomotor nerves.

Some of the oculomotor root fibres have a crossed origin, though most of them are direct. Van Gehuchten has recently studied this question by the degeneration method of Nissl, confirming and adding to the data of former investigators. The crossed fibres of the third nerve in the rabbit arise from the dorsal part of the nucleus. The nerves for the m. rectus superior (and perhaps for the m. levator palpebræ) are mainly of crossed origin, while a very few fibres for the mm. obliquus inferior and rectus internus are also crossed. Though the fibres of the IV. nerve all appear to cross in the valvula, yet a very few cells of the nucleus of the same side are affected by the process of chromatolysis (in the rabbit). No fibres of the VI. nerve have a crossed origin.

The eye muscles are provided with the usual muscular sensory organs (muscle spindles and tendon organs), and these have been shown by Sherrington to be supplied by sensory fibres which come out with the so-called motor roots of their nerves, and not to be derived from the anastomosing twigs from the trigeminus. Their internal connections are unknown.

The great clinical importance of oculomotor symptoms has been a stimulus for much research upon the secondary connections of the oculomotor nuclei. Nevertheless, our knowledge of these connections is still very incomplete. Certain cells in the pregeminum which are related to the termini of the optic nerve in this region appear to send their neurites into the fasciculus longitudinalis medialis, and thus put the terminal nuclei of the optic nerve into relation with the nuclei of the eye-muscle nerves, for it is well known that all of these nuclei are related to this fasciculus. Kölliker, Darkschewitsch, and others have described other connections between the opticus and the oculomotorius. The fasciculus longitudinalis medialis, according to Kölliker, also

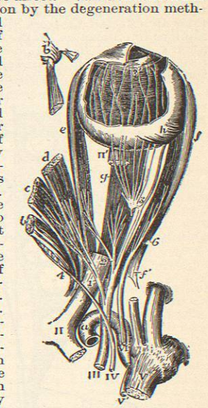

FIG. 1565.—View from Above of the Motor Nerves of the Eyeball and Its Muscles. (From Quain's "Anatomy.")

a, Upper part of the internal carotid artery emerging from the cavernous sinus; *b*, superior oblique muscle; *b'*, its anterior part passing through the pulley; *c*, levator palpebræ superioris; *d*, superior rectus; *e*, internal rectus; *f*, external rectus; *f'*, its upper tendon turned down; *g*, inferior rectus; *h*, insertion of inferior oblique muscle; II, optic commissure; II', part of the optic nerve entering the eyeball; III, common oculomotor; IV, trochlearis; V, large root of the trigeminus; V', small, or motor root; VI, abducens; 1, upper division of III. nerve, giving twigs to the levator palpebræ and superior rectus; 2, branches of the lower division supplying the internal and inferior recti muscles; 3, the long branch of the same nerve, proceeding forward to the inferior oblique muscle, and close to the number 3 the short root of the ciliary ganglion; this ganglion is also shown receiving from behind its long root, which has been cut short, and giving forward some of its ciliary nerves which pierce the sclerotic coat; 3', marks the termination of some of these nerves in the ciliary muscle and iris, after having passed between the sclerotic and choroid coats; 4, the trochlear nerve entering the upper surface of the superior oblique muscle; 6, the abducens nerve passing into the external rectus.

serves as a path of communication between the sensory nerves of the cord and oblongata and the oculomotor nuclei, and the VI. nucleus receives collaterals directly from the sensory root of the V.

All of the oculomotor nuclei receive collaterals from the pyramidal tract which arborize about their cells, and doubtless constitute the paths of conduction of oculomotor impulses from the cortex. The lower cervical and upper thoracic region of the spinal cord contains a "cilio-spinal centre" controlling certain oculomotor movements, particularly dilatation of the pupil, elevation of the upper lid, and protrusion of the eyeball. These connections are effected through the great sympathetic via the rami communicantes of the lower roots of the brachial plexus. All of the oculomotor nuclei of each side are probably intimately related through the fasciculus longitudinalis mediaiis. Duval and Laborde have described

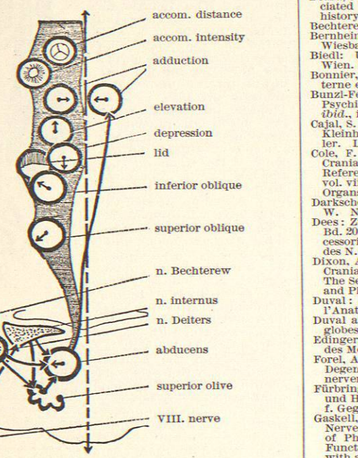

FIG. 1566.—Diagram of the Ampullo-Oculomotor Connections. (After Bonnier.)

also a tract from the VI. nucleus to the III. and IV. nuclei of the opposite side, particularly to the centre for adduction in the III. nucleus, thus providing a direct neural connection for conjugate movements of the eyes in the horizontal plane. The supposed course of the tract is diagrammed in Fig. 1566. Recent degeneration experiments on the lower animals have not revealed this tract; some such connection (either by way of this tract or of the fasciculus longitudinalis medialis to the opposite root fibres of the III. nerve) is, nevertheless, called for by abundant clinical data.

Various connections between the VI. nucleus and the vestibular portion of the auditory nucleus have been described. There is a great mass of clinical and direct experimental evidence for an intimate connection between the primary centres for the ampullæ of the internal ear and the oculomotor centres, particularly those for conjugate movements of the eyes in the horizontal plane. It is these horizontal motions which are shown by experiment to be most in need of compensation in order to avoid an underestimate of angular movements of the head due to the inertia of the eyeballs. It is significant in this connection that the abductors and adductors of the eyeball are in most intimate connection with the vestibular apparatus, according to the results of Duval and Laborde. The accompanying diagram from Bonnier illustrates a possible arrangement of these connections, though it should be remembered that they are all more or less in dispute (Fig. 1566). *C. Judson Herrick.*

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CREASOTE. See *Creosote.*

CREMATION. See *Dead Bodies, Disposal of.*

CREOLIN is a German proprietary article. Commercial creolin, however, varies much in appearance, and many preparations are sold under that title. The cresols form the active ingredients. The following analysis of the German compound is furnished by Dr. Bernard Fischer: Cresols, 20 parts, naphthalene, 18 parts; other hydrocarbons, 20 parts; and non-volatile matter, 42 parts. It is quite free from carbolic acid and other poisonous ingredients, and should not possess any toxic properties. Creolin is prepared by treating these insoluble hydrocarbons with resin and caustic potash, which form a resinous, soapy emulsion. When added to water and agitated the ingredients remain suspended as an emulsion. In appearance it is a dark, resinous liquid, neutral to test paper, not caustic. Its odor resembles that of creosote. It mixes with oils.

It is said to possess powerful antiseptic and disinfectant properties, and is recommended as a substitute for carbolic acid. It is very extensively employed, and numerous reports speak in its favor in all conditions in which carbolic acid is indicated.

For surgical purposes two solutions are employed, one containing two per cent. of the drug, the other one-half per cent. The stronger is used for disinfecting the hands, the instruments, and surfaces of the body; the weaker solution is used for irrigation, moistening dressings, saturating tampons, etc.

For suppurating and sloughing wounds, and when discharges are offensive the parts may be cleansed and disinfected by the pure drug, and the effect maintained by a weaker solution. To irrigate the bladder, urethra, nose, pharynx, and other mucous surfaces, a solution of one part in a thousand is sufficiently strong.

The objections to its use are, the uncertainty of its action on account of the numerous preparations, and being unctuous it renders the hands and instruments slippery and difficult to handle. *Beaumont Small.*

CREOSIN is a clear yellow fluid of not unpleasant taste composed of creosote, iodine, calcium hypophosphite, and balsam of Peru. It is free from causticity or other unpleasant by-effects, its taste is not disagreeable, and it is freely miscible with wine, milk, or soup. It was introduced by Bosio as a useful method of administering creosote, and is used like it in phthisis, bronchitis, bronchiectasis, etc. *W. A. Bastedo.*

CREOSOTE.—The title *creosote* belongs to a product of distillation of wood-tar, and much confusion has arisen from its application also to certain products of distillation of coal-tar, as in the title *coal-tar creosote.* This confusion, furthermore, has been worse confounded by the too frequent commercial trick of selling the coal-tar product in substitution for the wood-tar *creosote* proper. True creosote is recognized by the United States Pharmacopœia under the title *Creosotum*, Creosote, and is defined to be "a mixture of phenols, chiefly guaiacol and creosol, obtained during the distillation of wood-tar, preferably of that derived from the beech."

Creosote is "an almost colorless, yellowish or pinkish, highly refractive, oily liquid, having a penetrating, smoky odor, and a burning, caustic taste; usually becoming darker in tint on exposure to light. Specific gravity not below 1.070 at 15° C. (59° F.). Soluble in about 150 parts of water at 15° C. (59° F.), but without forming a perfectly clear solution. With 120 parts of hot water it forms a clear liquid which on cooling becomes turbid from the separation of minute oily drops. . . . Soluble, in all proportions, in absolute alcohol, ether, chloroform, benzin, carbon disulphide, acetic acid, and fixed and volatile oils" (U. S. P.). A notable point of difference between creosote and carbolic acid is that creosote does not coagulate albumen or collodion, while carbolic acid does.

Creosote is closely related, chemically, to carbolic acid, and resembles that body in physiological properties. Creosote, however, while equalling carbolic acid in antiseptic power, is distinctly less poisonous to the animal economy. Because of this circumstance creosote has been used as an internal medicine in such diseases as pulmonary consumption, in the hope of arresting the morbid process through a poisoning, within the body of the patient, of the peccant micro-organism. But whatever good may result from the treatment, it is quite certain that, as creosote is used internally, it does not affect the vital endowments of the tubercle bacillus.

Creosote tends to allay reflex nausea and vomiting, and to benefit pulmonary catarrhs, in the stage of active secretion.

For ordinary purposes creosote is prescribed in doses of a few drops, to be taken preferably in capsule, and upon a *full* stomach. Considerable quantities, however,