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VOLUME 3

HEAD AND NECK AND BRAIN

FOURTEENTH EDITION

G. J. ROMANES

CUNNINGHAM'S MANUAL OF PRACTICAL ANATOMY

FOURTEENTH EDITION

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PREFACE

THIS volume has been rewritten on the same principles as the other two. The order of dissection has been changed so that the median section of the skull and pharynx is carried out at an earlier phase. This allows the student to expose the entire length of the neurovascular bundle of the neck early in the dissection and to follow many structures into the walls of the nasal, oral, and pharyngeal cavities, thus giving an opportunity of relating the structures to these parts of the body which are readily examined in the living.

Accounts of the skull and cervical vertebrae are included, and all the illustrations of the bones are repeated in an atlas at the end of the book for ready reference. The development of the face, mouth, nasal cavities, and pharynx and of the central nervous system are included in a separate section. They are not placed in the appropriate parts of the book because the face, oronasal, and pharyngeal regions are best dealt with together if a proper understanding of their formation is to be obtained without undue repetition.

Tables of movements, the muscles which produce them, and the nerve supply of these muscles are also included. Several new illustrations have been added, principally in the osteology and central nervous system sections, but also to show the general structure of the head and neck and the distribution of arteries and nerves to them.

These additions, and the inclusion of a greater number of points of clinical interest, have increased the overall length of the volume in spite of the removal of a considerable amount of unnecessary detail, but it is hoped that they will improve the usefulness of the book and make it more able to meet the requirements of medical students without recourse to a number of other texts.

I am indebted to Professor E. W. Walls for reading the manuscript and making many helpful suggestions, and also to Dr. J. C. Gregory for his careful handling of the many publication problems.

Edinburgh
March 1977

G. J. Romanes

THE HEAD AND NECK

As a preliminary to the dissection of the head and neck, the dissectors should study the cervical vertebrae and skull, relating their main features to the bony points which can be felt. A sound knowledge of these structures and of those which pass through or are attached to them is necessary for an understanding of this region. The following brief accounts should be studied together with the vertebrae and a skull from which the skull-cap has been removed, so that the various points can be confirmed.

THE CERVICAL VERTEBRAE

There are seven cervical vertebrae. The third to the sixth are typical, but the first and second are modified to permit movements of the head on the neck, and the seventh shows some features of a thoracic vertebra. All seven have a foramen (foramen transversarium) in each transverse process.

Cervical vertebrae are smaller and more delicate than their thoracic and lumbar counterparts—they carry less weight—but they have a larger vertebral foramen to accommodate the cervical swelling of the spinal medulla.

In the following descriptions, individual cervical vertebrae are identified as C. 1, C. 2, C. 3, etc.

THE TYPICAL CERVICAL VERTEBRAE

Body. This is oval in plan, with its long axis transverse. The superior surface is concave from side to side, and has lateral margins that project upwards to articulate with the cut-away inferolateral margins of the body above.

Pedicles. These are short, and pass outwards and backwards from the middle of the posterolateral parts of the body to form the posteromedial wall of the foramen transversarium.

Laminae. These are long and rectangular, and almost overlap their neighbours in extension.

Spines are short and bifid.

Articular Facets. These are the obliquely cut ends of a short rod of bone, the articular process, lying at the junction of the pedicle and lamina on each side. The superior facets face upwards and backwards, the inferior pair downwards and forwards.

Vertebral Foramen. It is large and triangular.

Transverse Processes. Each is short and perforated by the foramen transversarium. Anterior to the foramen, the costal process (corresponding to a rib) projects laterally from the body to end in the anterior tubercle (attachment of scalenus anterior

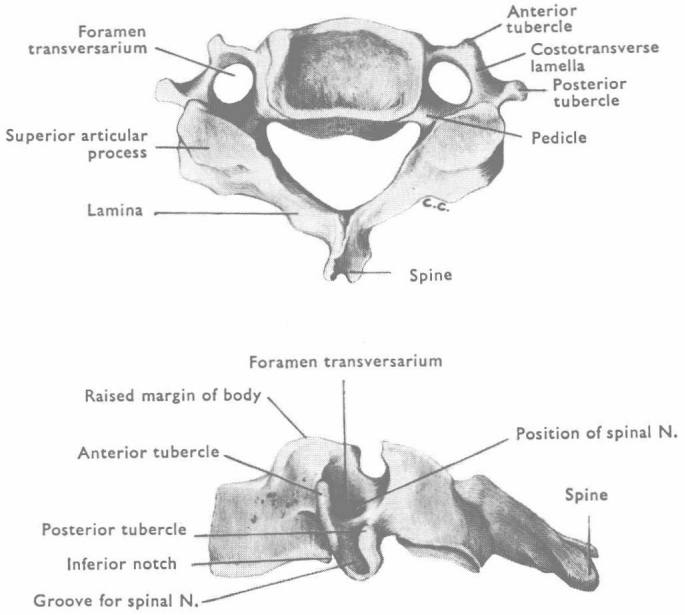

FIG. 1 The fourth cervical vertebra, superior and left surfaces.

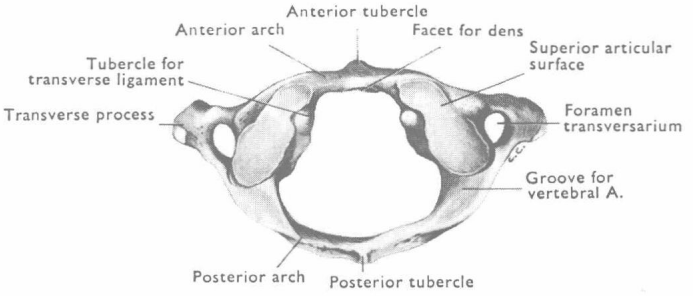

FIG. 2 The upper surface of the atlas.

and longus capitis). Behind the foramen, the true transverse process projects laterally from the junction of the pedicle and lamina to end in the posterior tubercle (attachment of scalenus medius, levator scapulae, etc.). The slip of bone which unites the tubercles and completes the foramen transversarium is concave superiorly to lodge the ventral ramus of the corresponding spinal nerve.

Foramen Transversarium. It transmits the vertebral artery, vertebral veins, and sympathetic plexus, and lies anterior to the ventral ramus of the spinal nerve.

THE ATYPICAL CERVICAL VERTEBRAE

C. 1 (the Atlas). It has no body and consists simply of two **lateral masses** united by an anterior and a posterior **arch**. The body is represented by the **dens**, a tooth-like projection from the superior surface of the body of C. 2, and each pedicle by part of the corresponding lateral mass. The **laminae** form the posterior arch which grooved on its superior surface, behind the lateral mass, by the vertebral artery and the first cervical ventral ramus. The spine is replaced by the **posterior tubercle**. The superior and inferior **facets** lie on the lateral masses anterior to the first and second cervical nerves respectively. The superior is concave and kidney-shaped; the inferior is almost circular, slightly concave, and faces downwards and medially. An inward projection from each lateral mass gives attachment to the **transverse ligament** which divides the vertebral foramen into a small anterior compartment for the dens, and a larger, oval, posterior compartment for the spinal medulla and its coverings. The **transverse process** of the atlas is long and thick, and lacks an anterior tubercle. Its **foramen transversarium** is lateral to those below.

C. 2 (the Axis). The salient feature is the **dens**. This is held against the anterior arch of C. 1 by the **transverse ligament**. There are articular facets on the arch and dens, and the posterior surface of the dens is grooved by the ligament.

On each side, the thick **pedicle** is covered by the **superior articular facet** which also lies partly on the body (lateral to the dens) and on the base of the costal process. This facet overlies the foramen transversarium, and is flatter than the inferior facet of C. 1 which it fits. The inferior facet of the axis is typical.

The **laminae** are considerably thickened for muscle attachments, and carry a massive **spine**. The transverse process has no anterior tubercle. The **foramen transversarium** turns laterally through 90 degrees under the superior articular facet so that its exit is visible from the lateral aspect.

C. 7. The **spine** is long and non-bifid, the **transverse process** lacks an anterior tubercle,

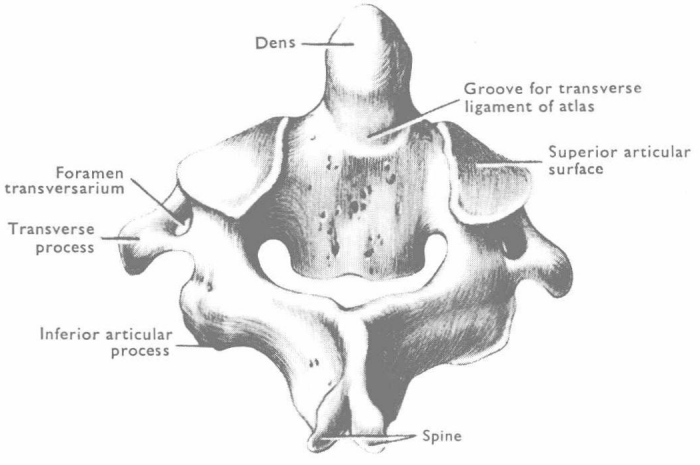

FIG. 3 The axis vertebra from behind and above.

and the **foramen transversarium** transmits only veins.

PALPABLE PARTS OF CERVICAL VERTEBRAE

The **spine of C. 2** in the nape of the neck about 5 cm below the external occipital protuberance.

The **spine of C. 7** (vertebra prominens) where the collar band crosses the posterior median line of the neck.

The **transverse process of C. 1** through the anterior border of sternocleidomastoid immediately below the tip of the mastoid process.

THE SKULL

[FIGS. 4–12]

GENERAL ARCHITECTURE OF SKULL

The skull consists of a brain-box or cranium and a facial skeleton. The **cranium** surrounds the brain and its coverings (meninges) and deepens from before backwards to accommodate them. The **facial skeleton** is slung beneath the shallow, frontal part of the cranium the anterior wall of which forms the bone of the forehead (**frontal bone**), while the floor (frontal and **ethmoid bones**) forms the roofs of the orbits (sockets for the eyeballs) and of the nasal cavities, and sends a wall (nasal septum) downwards between these cavities.

The main elements of the facial skeleton are the right and left **maxillae**. These bear the upper teeth in the curved alveolar process which projects inferiorly from each. The body of each maxilla lies below the corresponding orbit and lateral to the lower part of the nasal cavity. It contains the **maxillary air sinus**, and has the shape of a three-sided pyramid lying with its base medially. The **surfaces** are anterolateral (anterior), posterolateral (infratemporal), and superior (orbital), and the base lies in the lateral wall of the nasal cavity. The apex points laterally and is overlaid by the **zygomatic** (cheek) **bone** which extends its attachment to the maxilla by sending processes along each edge of the pyramid. The zygomatic bone forms one of the main buttresses attaching the maxilla to the cranium by extending upwards on the lateral margin of the orbit (**frontal process**) to meet the frontal bone, and backwards (**temporal process**) to join the zygomatic process of the temporal bone and complete the **zygomatic arch**. Of the extensions of the zygomatic bone on the maxilla, that between the orbital and anterior surfaces forms the lateral half of the inferior margin of the orbit, that between the anterior and infratemporal surfaces is a heavy buttress preventing upwards displacement of the maxilla, and that between the orbital and temporal surfaces is a deep flange from the frontal process of the zygoma. This flange unites with the greater wing of the sphenoid

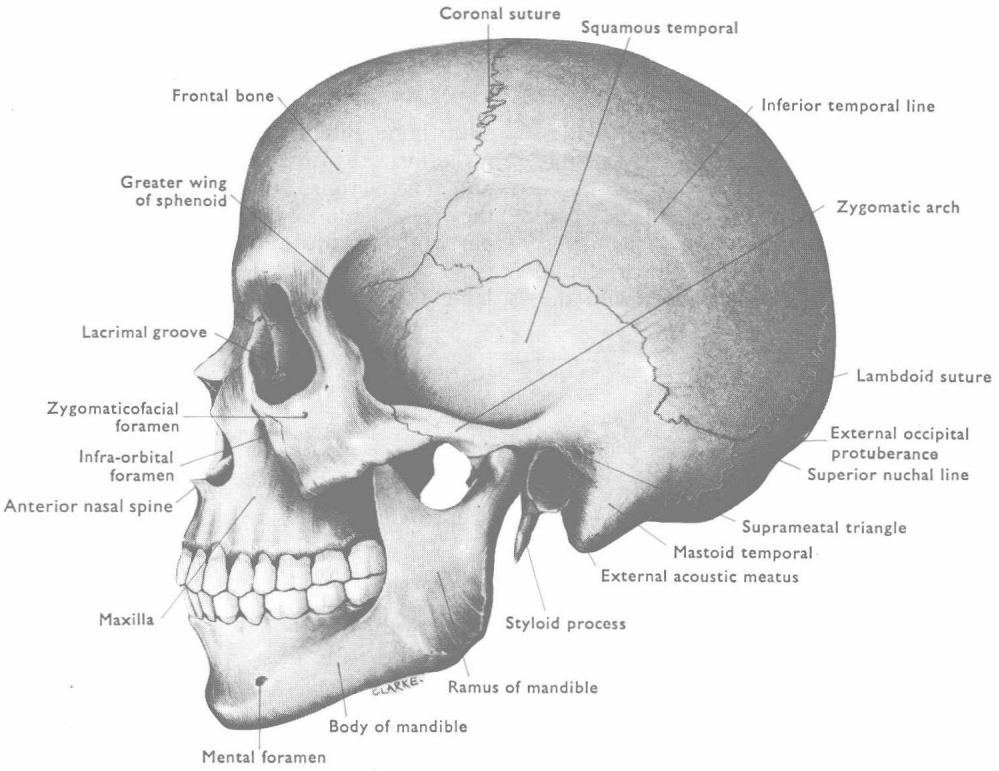

FIG. 4 Lateral view of the skull.

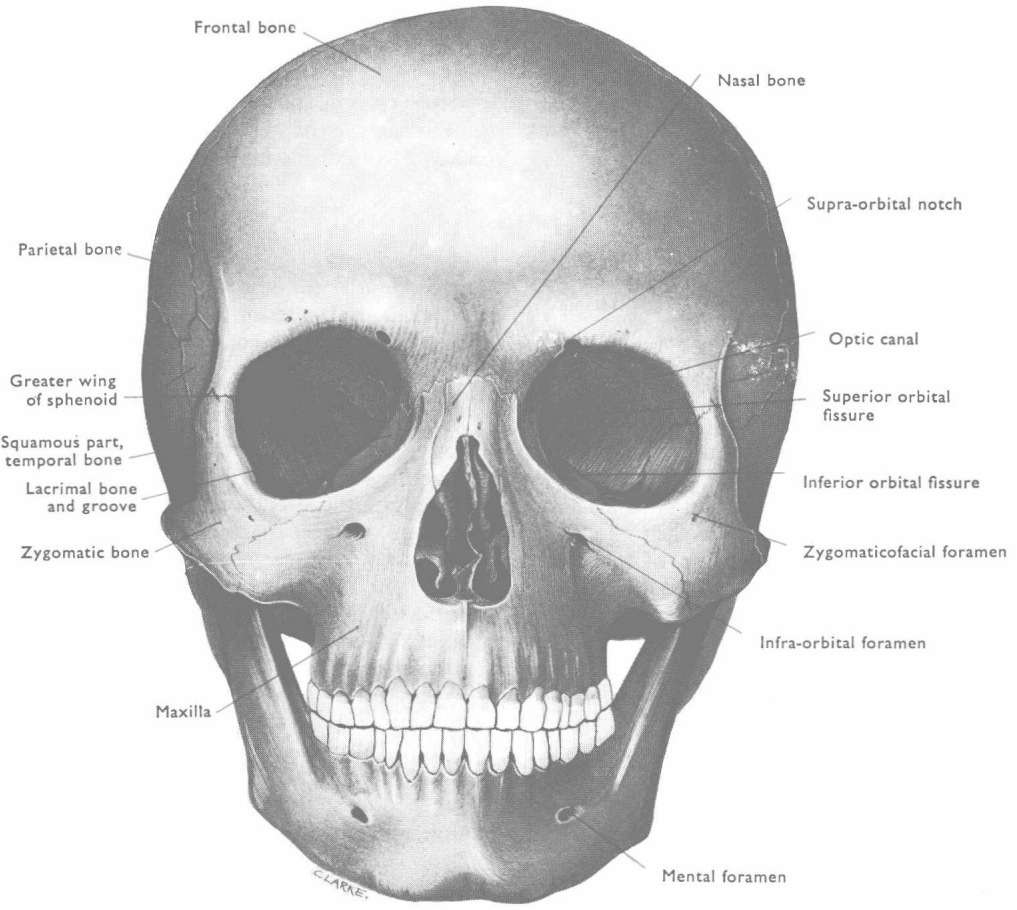

FIG. 5 Anterior view of the skull.

bone to form the **lateral wall of the orbit**, separating it from the temporal fossa deep to the zygomatic arch [FIG. 10].

Medial to the orbit, the maxilla is directly attached to the cranium by a **frontal process**. This forms the lower part of the medial margin of the orbit and articulates with the frontal bone above, with the nasal bone anteriorly, and with the lacrimal bone posteriorly to form the **fossa for the lacrimal sac**. The lacrimal bone articulates posteriorly with the orbital lamina of the ethmoid to form the greater part of the **medial wall of the orbit**, separating it from the upper part of the nasal cavity. The orbital lamina of the ethmoid and the lacrimal bones extend

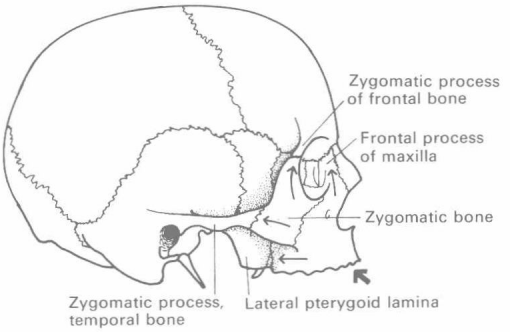

FIG. 6 Lateral view of skull to show the parts of the facial skeleton which transmit to the cranium forces applied to the maxilla. The thick arrow represents the force applied – the thin arrows the lines of transmission. These are the parts of the skull liable to fracture in blows to the face.

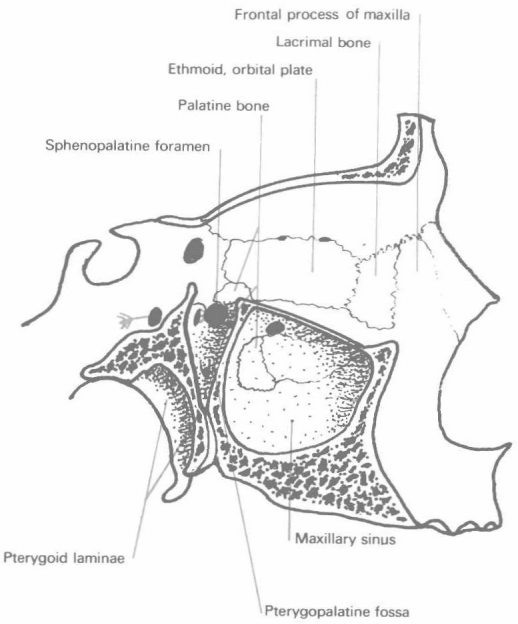

FIG. 7 Lateral view of sagittal section through anterior part of skull to show pterygopalatine fossa, and the construction of the medial wall of the orbit. Arrow in foramen rotundum.

from the orbital surface of the maxilla below to the frontal bone above, and are very thin plates of bone which add nothing to the strength of the attachment of the maxilla to the cranium. The **ethmoidal foramina** lie in the fronto-ethmoidal suture.

Posteriorly, where the infratemporal surface of the maxilla meets its base, two plates of bone (**pterygoid laminae**) extend downwards and forwards from the sphenoid bone in the base of the cranium to articulate inferiorly with the maxilla through a process of the palatine bone. They form yet another buttress attaching the maxilla to the cranium. Above, the pterygoid laminae are separated from the maxilla by the narrow **pterygomaxillary fissure** which is continuous superiorly with the **inferior orbital fissure** between the lateral wall and floor of the orbit. The importance of the buttresses which hold the maxilla to the cranium (zygomatic bone and arch, frontal process of the maxilla, and pterygoid laminae) is that they are fractured when heavy blows displace the facial skeleton.

The two maxillae are firmly united in the median plane by the articulation of the alveolar processes anteriorly and of their **palatine processes** posteriorly. These horizontal plates, which extend inwards from the upper margins of the alveolar processes, also articulate with the corresponding processes of the palatine bone posteriorly, thus completing the hard palate which separates the nasal cavities from the mouth. The **palatine bone** is an L-shaped plate. Its horizontal lamina forms the posterior one-third of the palate. The **perpendicular lamina** forms the lateral wall of the nasal cavity between the maxilla in front and the medial pterygoid lamina behind. Thus it separates the pterygomaxillary fissure from the nasal cavity except superiorly where a notch in the upper margin of the perpendicular lamina forms the **sphenopalatine foramen** with the sphenoid bone. This arrangement can be seen by looking at a skull which has been divided in the median plane.

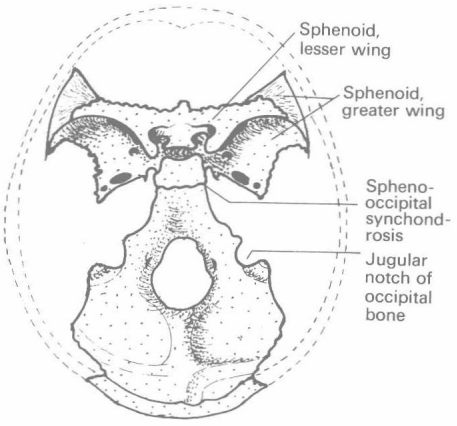

FIG. 8 The part of the internal surface of the base of the skull formed by the sphenoid and occipital bones. On each side a temporal bone is wedged between them. The frontal and ethmoid bones complete the anterior part.

THE CRANIUM

The cranium surrounds the brain and meninges much as the vertebrae surround the spinal medulla and its meninges, except that the cranium is a rigid structure composed of a number of interlocking bones which represent highly modified, fused vertebrae. A solid, median, inferior part of the cranium, which represents a number of fused vertebral bodies, is constructed from parts of two separate bones (the occipital and sphenoid [FIG. 8]) which unite in the adult. Lateral to this are several foramina which transmit nerves and blood vessels to laterally (**jugular process**) immediately posterior to the jugular foramen. This process corresponds to a transverse process, and lying immediately above that of the atlas, separates the ventral ramus of the first cervical nerve, inferiorly, from the 9th, 10th, and 11th cranial nerves in the **jugular foramen**. The **hypoglossal canals** for the 12th cranial nerves pierce the skull immediately above the occipital condyles.

Posterior to the foramen magnum, the occipital bone forms the greater part of the inferior surface of the cranium roughened by the attachment of the muscles of the back of the neck. This area is divided

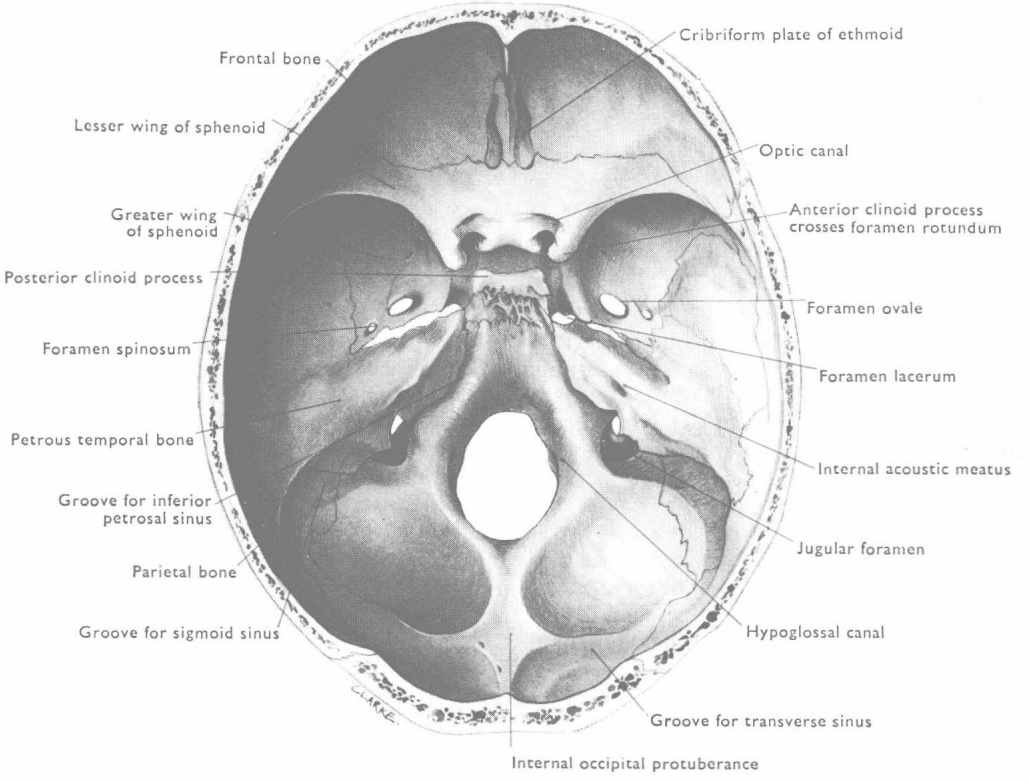

FIG. 9 Internal surface of the base of the skull.

and from the brain, and which correspond in position to the intervertebral foramina (*vide infra*).

The vault of the cranium represents the vertebral arches (pedicles and laminae) but only the **occipital bone**, by itself, forms a complete arch which surrounds the foramen magnum [FIG. 8] at the junction of the brain and spinal medulla. Like the vertebrae below it, the inferior margin of the foramen magnum has an oval, curved articular facet (**occipital condyle**) on each anterolateral surface. These articulate with the superior articular facets of the first cervical vertebra (the atlas [FIG. 2]). Lateral to each of these condyles, the occipital bone projects transversely by an ill-defined **inferior nuchal line** [FIG. 11] and is limited posteriorly by the **external occipital protuberance** in the midline and the **superior nuchal lines** extending laterally from it. At this line, the occipital bone turns upwards, deep to the back of the scalp, as a triangular plate inset between the posterior edges of the two parietal bones with which it forms the lambdoid suture. The **parietal bones** arch forwards from the lambdoid suture and form the greater and widest part of the dome of the skull. Anterior to the occipital bone they articulate with each other in the median plane (**sagittal suture**), and with the frontal bone

anteriorly in the transversely placed **coronal suture** [FIG. 4].

The **frontal bone**, consisting of right and left halves which usually fuse early in life, curves anteroinferiorly to the superior margins of the orbits and the root of the nose. Here it turns backwards to form the greater part of the roof of each orbit, separated by the part of the **ethmoid bone** (**cribriform plates**) which forms the roof of the nasal cavities [FIG. 9]. The ethmoid also forms a considerable part of the septum and lateral walls of these cavities. Posteriorly, the orbital parts of the frontal bone meet the lesser wings of the sphenoid bone [FIG. 9] to

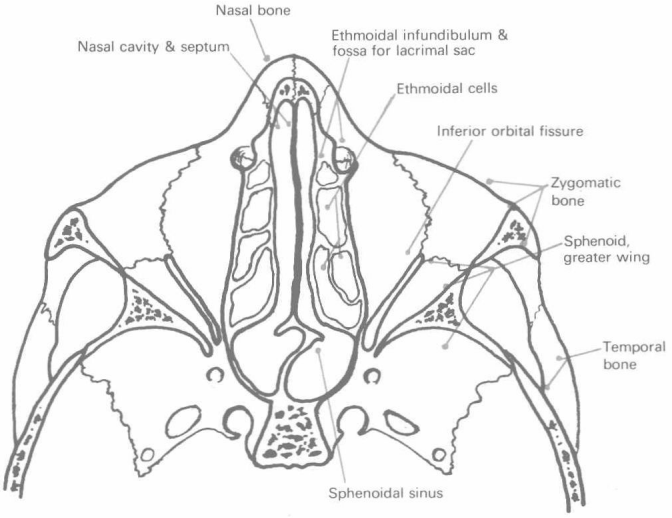

FIG. 10 Horizontal section of the anterior part of the skull through the orbits.

complete the **roofs of the orbits** and the floor of the **anterior cranial fossa** on which the frontal lobes of the brain lie.

The **sphenoid bone** consists of a median body which is hollowed out by an extension of each nasal cavity (the **sphenoidal air sinuses**), two greater and two lesser wings, and a pair of pterygoid laminae projecting downwards from the medial part of each greater wing.

The **body** of the sphenoid articulates with the nasal septum in the midline—the ethmoid anteriorly and the vomer inferiorly. Posteriorly it is fused to the basilar part of the occipital bone, just posterior to the vomer. This fusion replaces the growth cartilage which separates the two bones and is responsible for growth of the base of the skull until this ceases (18–22 years). Superiorly, the body forms the **sella turcica**. The central portion of this is the **hypophysial fossa** which is limited posteriorly by the **dorsum sellae**—a rectangular plate of bone which projects upwards with the **posterior clinoid processes** on its superolateral corners. Anteriorly, the fossa is limited by the tuberculum sellae with the horizontal **sulcus chiasmatis** in front of it. On each side this sulcus leads to an **optic canal** which transmits the corresponding optic nerve and ophthalmic artery. The sulcus does not lodge the optic chiasma in spite of its name. The hypophysial fossa is the median part of the **middle cranial fossa**. On each side it is continuous with the expanded lateral parts of this fossa which lodge the temporal lobes of the brain.

The **lesser wings of the sphenoid** project laterally from the anterosuperior part of the body. Each has a free, curved, posterior margin which forms the posterior limit of the anterior cranial fossa and ends medially in an **anterior clinoid process** immediately lateral to the optic canal. Laterally, the tip of each lesser wing reaches and fuses with the upturned edge of the corresponding greater wing of the sphenoid bone. This closes the lateral end of the **superior orbital fissure** which separates the two wings medially [FIG. 5] and is the route taken by structures passing between the middle cranial fossa and the orbit.

Each **greater wing** is roughly rectangular in shape with its long axis running anterolaterally,

parallel to the lateral wall of the orbit. The posteromedial angle is truncated and attached to the lowest part of the lateral surface of the body of the sphenoid well below the level of the lesser wing. The posterolateral angle projects backwards and has the **spine of the sphenoid** extending downwards from it immediately posterior to the small **foramen spinosum**. The anterior part of the rectangle is bent upwards. This produces a concave cerebral surface, while the external surfaces form the posterior part of the lateral wall of the orbit and part of the medial wall of the temporal fossa; both these surfaces unite anteriorly with the zygomatic bone. The upturned end articulates superiorly with the lesser wing and with the inferior surfaces of the frontal and parietal bones. Thus this part of the bone has orbital, temporal, and cerebral surfaces [FIG. 10]. Where the greater wing is bent upwards, there is usually a well-marked **infratemporal crest** on the inferior surface. Close to the body of the sphenoid, the greater wing is pierced by the **foramen rotundum** near the medial end of the superior orbital fissure, and posterior to this by the **foramina ovale** and **spinosum**. The pterygoid laminae project below the foramen rotundum.

The temporal is the remaining cranial bone. It is as though pushed into the lateral side of the skull to fill the semicircular gap below the inferior margin of the parietal bone and the interval between the occipital and sphenoid bones in the base [FIG. 8]. The **temporal bone** consists of a dense, three-sided pyramid (**petrous part**) wedged anteromedially between the greater wing of the sphenoid and the basilar part of the occipital bone. The apex of the pyramid does not reach the body of the sphenoid bone but leaves the **foramen lacerum** between them [FIG. 9]. The anterior and posterior surfaces of the pyramid are on the internal surface of the cranium, while the rough inferior surface is on the external aspect of the base. The posterior surface of the pyramid is pierced by the cylindrical **internal acoustic meatus**, and articulates medially with the sloping cranial surface of the median parts of the sphenoid and occipital bones (the clivus) at a groove which lodges the inferior petrosal sinus. This groove leads downwards on the articulation to the jugular foramen which expands laterally into the petrous temporal bone as the **jugular fossa**. Together the clivus and the posterior surfaces of the two petrous temporal bones form the anterior wall of the **posterior cranial fossa** which lodges the cerebellum and the greater part of the brain stem. The anterior surface of the pyramid forms the posterior part of the floor of the middle cranial fossa. The base of the pyramid is the **mastoid process** on the lateral aspect of the skull [FIG. 4]. It lies in the same transverse plane as the occipital condyles.

Fused with the anterolateral part of the petrous and with the superior aspect of its mastoid process is the semicircular **squamous part** of the temporal bone. This overlaps the external surfaces of the greater wing of the sphenoid and the inferior margin of the parietal bone (**squamosal suture**).

The **zygomatic process** of the temporal bone arises as a horizontal ridge from the lower part of the lateral surface of the squamous temporal. It turns forwards to join the temporal process of the zygomatic bone in the zygomatic arch. Below the root of the zygomatic process, the inferior surface of the squamous part has two transverse notches. The larger, anterior notch, is the mandibular fossa for articulation with the head of the mandible. The smaller, posterior notch, immediately anterior to the mastoid process, is converted into a canal (**external acoustic meatus**) by a U-shaped plate of bone which forms the anterior, lower posterior, and inferior walls of the meatus, and has a sharp flange projecting inferiorly from it. This **tympanic part** of the temporal bone fuses anteriorly with the squamous part (except medially where a strip of petrous temporal intervenes) and so extends the posterior wall of the mandibular fossa. Posteriorly, it fuses with the mastoid process and inferior surface of the petrous temporal bone. The middle of the inferior flange is partly wrapped round the **styloid process** which projects inferiorly from the petrous temporal bone between the jugular fossa and the external acoustic meatus. Immediately posterior to the base of the styloid process is the small **stylomastoid foramen** which transmits the facial (7th cranial) nerve. At the medial end of the flange, a circular opening in the inferior surface of the petrous temporal bone is the **carotid canal**. This transmits the internal carotid artery which turns anteromedially in the bone and emerges from its apex into the upper part of the foramen lacerum through which it enters the cranial cavity, grooving the lateral aspect of the body of the sphenoid bone.

The **mandibular fossa** is limited anteriorly by the articular tubercle which is continuous laterally with the tubercle on the root of the zygomatic process. The smooth, articular surface of the tubercle is continuous with the mandibular fossa posteriorly—a feature which indicates the movement of the head of the mandible on to the tubercle when the mouth is opened or the jaw protruded. The articular surface for the mandible extends medially almost to the spine of the sphenoid and anteriorly beyond the root of the zygomatic process.

Features of External Surface of Base of Skull

It is important to appreciate that the posterior two-thirds of the base of the skull overlies and is continuous with structures in the neck. Anterior to this, and overlapping it laterally, are the structures passing from the skull to the jaws and orbit.

Posteriorly, the mouth and nasal cavities enter a common chamber—the **pharynx**. This is the cranial end of the gut tube which divides inferiorly into a median airway (larynx and trachea) and foodway

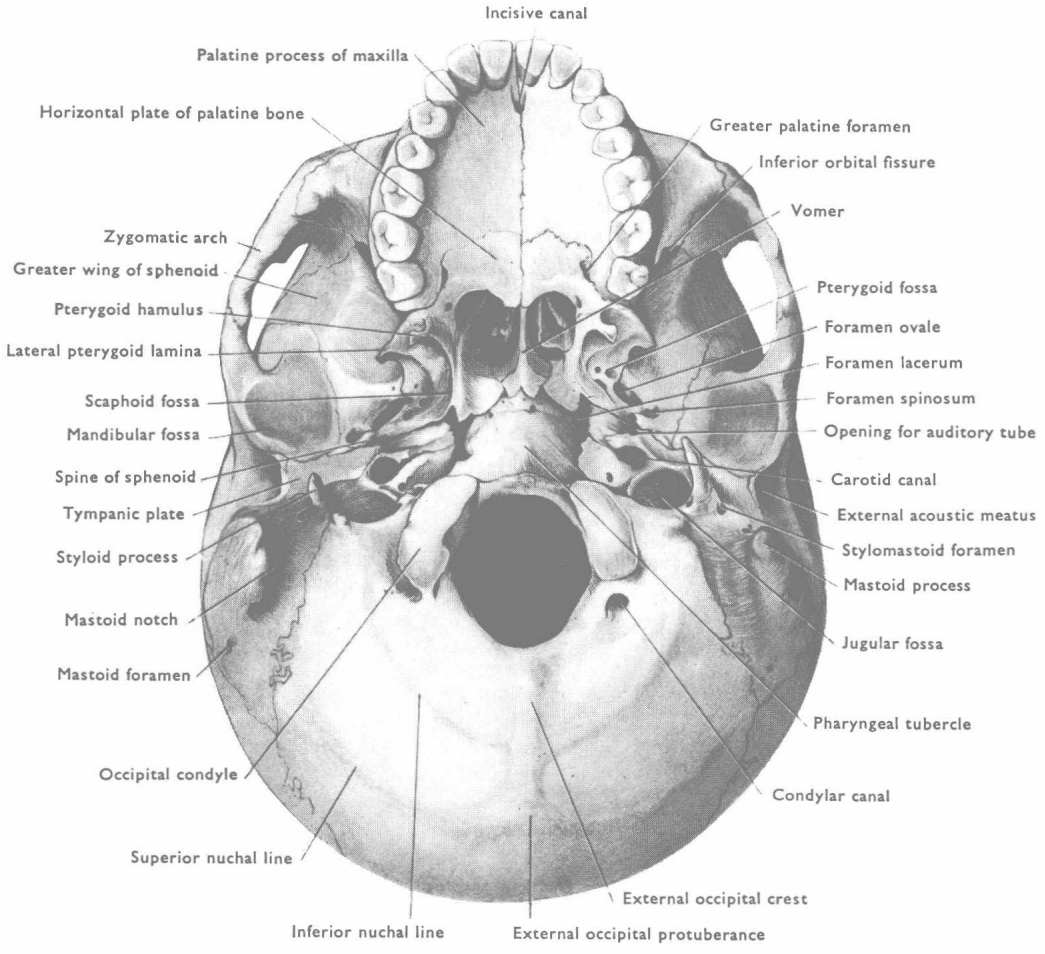

FIG. 11 The external surface of the base of the skull.

(laryngeal part of the pharynx and oesophagus) anterior to the vertebral column. The uppermost (nasal) part of the pharynx extends to the base of the skull where it is continuous anteriorly with the nasal cavities. Behind this it is closed by a musculo-fascial wall each half of which curves backwards from the posterior edge of the corresponding medial pterygoid lamina and the pterygoid hamulus [FIG. 11] to meet its fellow in a median raphe. This is attached above to the **pharyngeal tubercle** on the basilar part of the occipital bone, 1 cm anterior to the foramen magnum. Inside this curved wall is the pharyngeal part of the base of the skull [FIG. 12].

Immediately behind each medial pterygoid lamina, the upper part of the pharyngeal wall is pierced by the cartilaginous **auditory tube**. This passes posterolaterally from the pharyngeal cavity in the groove between the greater wing of the sphenoid and the petrous temporal on the inferior aspect of the skull. At the root of the spine of the sphenoid, the tube becomes bony and opens into the middle ear cavity. It maintains a pressure equilibrium between that cavity and the pharynx. Below the level of the palate, the pharynx opens into the mouth anteriorly. Here the walls of the pharnyx are continuous with the muscle (buccinator) and fasciae of the cheeks.

Posterior to the pharyngeal area on the base of the skull is the area for articulation with the vertebral column and for attachment to the pre- and post-vertebral muscles of the neck [FIG. 26].

Immediately anterior to the jugular process of the occipital bone is the **jugular foramen** with the carotid canal in front of it. These foramina lie posterolateral to the wall of the pharynx and transmit the structures which descend in this position as the neurovascular bundle of the neck—internal jugular vein, carotid artery, and vagus nerve. In its upper part this bundle also contains the 9th and 11th cranial nerves, which emerge through the jugular foramen, and the 12th cranial nerve which leaves the skull through the hypoglossal canal immediately medial to the jugular foramen.

Deep to the zygomatic arch is the **temporal fossa**. Between the infratemporal crest on the greater wing of the sphenoid and the lateral pterygoid lamina is the **infratemporal fossa**. These two fossae and the zygomatic arch give rise to most of the muscles of mastication. The mandibular nerve which supplies these muscles leaves the skull through the foramen ovale in the medial part of the roof of the infratemporal fossa, close to the auditory tube and the lateral wall of the pharynx.

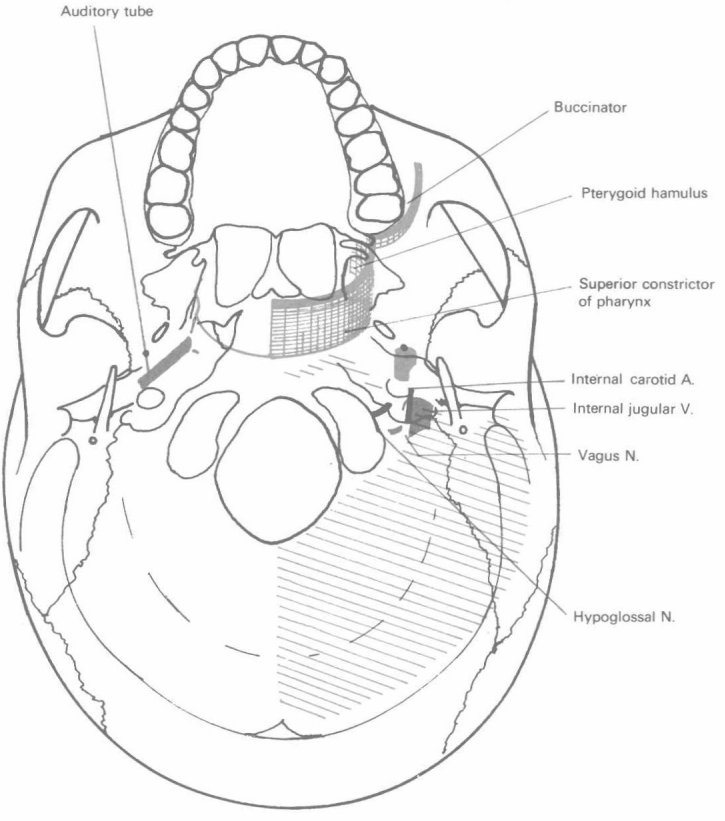

FIG. 12 External surface of base of skull to show the position of the superior constrictor, buccinator, and the auditory tube.

SURFACE ANATOMY

Begin by identifying the parts of the head mentioned in the following paragraphs by examining your own head and those of your partners.

Auricle

The main parts of the auricle are shown in FIGURE 16. It lies nearer the back of the head than the front, and is at the level of the eye and the nose. Hairs project backwards from the tragus and, particularly when they thicken after middle age, may prevent small foreign bodies from entering the external acoustic meatus.

Back and Side of Head

The **external occipital protuberance** is the knob felt in the median line where the back of the head joins the neck. From this, an indistinct, curved ridge, the **superior nuchal line**, extends laterally on each side between the scalp and the neck. Each line passes towards the corresponding **mastoid process**—a rounded bone behind the lower part of the auricle. Press your finger tip into the hollow below and in front of the mastoid process; the resistance felt is due to the transverse process of the atlas vertebra. It is overlaid by the lower part of the parotid salivary gland, the anterior border of the sternocleidomastoid muscle, the accessory nerve, and lies at the level of the lower border of the nasal orifices.

On a skull, identify the **supramastoid crest**. It is a blunt ridge which begins immediately above the external acoustic meatus and curves postero-superiorly. It is continuous superiorly with the **temporal line** which curves forwards making the upper limit of the temporal region. This line can only be felt distinctly at the lateral end of the eyebrow. The **parietal** and **frontal tubera** are the most convex parts of the corresponding bones.

Face

External Nose. The term 'nose' also includes the paired cavities which extend posteriorly from the nostrils to open into the pharynx. The mobile, anterior part of the nose consists of skin and cartilage; the rigid upper part is formed by the two **nasal bones**—the bridge of the nose—and by the two **frontal processes of the maxillae** [FIG. 5]. The skin is adherent to the cartilages, but is mobile over the bones. The part of the cavity of the nose immediately above each nostril is the **vestibule of the nose**. The vestibule is lined by hairy skin, and its lateral wall is slightly expanded to form the **ala** of the nose.

Lips, Cheeks, and Teeth

The lips and cheeks are composed chiefly of muscle and fat covered with skin and lined with mucous membrane. The space that separates the lips and cheeks from the teeth and gums is the **vestibule of the mouth**. A full set of adult **teeth** consists of 32—8 in each half jaw. From before backwards these are—2 incisors, 1 canine, 2 premolars, and 3 molars. There are 20 milk teeth, *i.e.*, 5 in each half jaw—2 incisors, 1 canine, and 2 'milk' molars. The **oral fissure**, between the lips, is opposite the biting edges of the upper teeth, the corner or angle of the mouth is opposite the first premolar tooth. The **philtrum** is the median groove on the external surface of the upper lip. The deep surface of each lip is attached to the gum by a median fold of mucous membrane, the **frenulum of the lip**.

Mandible

Identify the horizontal **body** of the mandible below the lower lip and the cheeks. Follow the lower border of the mandible backwards to its **angle**. This is the postero-inferior part of the **ramus** of the mandible—a wide, flat plate of bone which extends superiorly from the posterior part of the body and

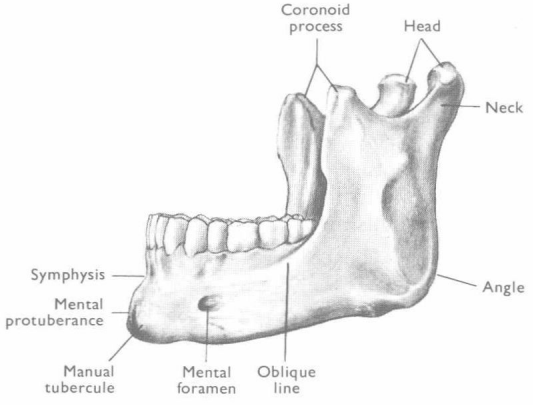

FIG. 13 Mandible as seen from the left side.

ends above in the **condylar** and **coronoid processes**. The ramus of the mandible is covered laterally by the masseter muscle so that only its posterior border is easily felt. The condylar process projects upwards from the posterior margin of the ramus and forms the **head** and **neck** of the mandible. The neck lies immediately anterior to the lobule of the auricle, the head is anterior to the tragus. Place your finger tip in front of your own tragus, and open your mouth; the head of the mandible glides downwards and forwards, leaving a fossa into which the finger slips. Note that the mouth cannot be closed while the finger remains in this fossa. Find the **mental foramen** about 4 cm from the median fusion of the two halves of the mandible (**symphysis menti**) and half way between the edge of the gum and the lower border of the mandible. It is felt in the living as a slight depression.

Zygomatic Arch

This bony bridge spans the interval between the ear and the eye. The zygomatic process of the temporal bone forms its narrow posterior part. It begins at the **tubercle** immediately anterior to the head of the mandible when the mouth is shut but above it when the mouth is open. The zygomatic bone forms the broad, anterior part of the arch in the prominent part of the cheek, lateral to and below the orbit.

Orbit

The bony structure of the orbit has been described already. Palpate the orbital margins in yourself and find (1) the **supra-orbital notch** on the highest point of the superior margin about 2·5 cm from the midline; (2) the **frontozygomatic suture** which is marked by a notch on the posterior surface [FIG. 5].

Eyebrow

This hairy skin lies above the supraorbital margin. Over its medial end is a curved ridge of bone, the superciliary arch. This is well formed only in males, and is separated from its fellow by the smooth, median **glabella**.

Eye

The white of the eye is the **sclera**, the clear front is the **cornea**. Through the cornea can be seen a dark, circular aperture, the **pupil**, surrounded by the coloured **iris**. The size of the pupil varies inversely with the degree of contraction of the iris on exposure to increasing intensity of illumination. The visible part of the sclera is covered with a moist, transparent membrane, the **conjunctiva**. This passes from the sclera on to the deep surfaces of the eyelids and is continuous with the skin at their margins. The reflexion of the conjunctiva on to the eyelids is the **fornix of the conjunctiva**, and the entire conjunctiva forms the **conjunctival sac**. This opens anteriorly between the eyelids through the palpebral fissure. It also forms the **anterior epithelium of the cornea**.

Eyelids

These folds or palpebrae protect the front of the eye and moisten it by spreading lacrimal fluid with each blink. The upper lid is larger and more mobile than the lower, and the upper conjunctival fornix is much the deeper. When the eye is closed, the **palpebral fissure** is nearly horizontal and lies opposite the lower margin of the cornea; when open, the margins of the eyelids overlap the cornea slightly, more especially the upper lid.

In the medial angle of the eye is a small, triangular space, the **lacus lacrimalis**, with a reddish elevation, the **lacrimal caruncle**, near its centre. This carries a few fine hairs which collect any debris in the conjunctival sac. Just lateral to this is a small, vertical fold of conjunctiva, the **plica semilunaris** [FIG. 14]. This corresponds to the nictitating membrane of some animals, but is not mobile in Man.

The lower eyelid is easily everted by pulling down the skin below it, and the lower fornix exposed by turning the eye upwards. The upper lid is difficult to evert because of the rigid **tarsal plate** buried in it, and once everted tends to remain so. Even when this is done the deep superior fornix is not exposed.

On the deep surface of the lids note a number of yellowish, parallel streaks produced by the **tarsal glands** [FIG. 14] the ducts of which open near the posterior margin of the flat, free edges of the lids. The eyelashes (**cilia**) project from the anterior margins. The free margins of the lids are rounded at the caruncle. Where they become flat, there is a small **lacrimal papilla** on each lid surmounted by a tiny aperture, the **lacrimal punctum**. This is the open end of a slender tube, the **lacrimal canaliculus**, which carries the lacrimal fluid (tears) to the lacrimal sac, whence it is conducted to the nose through the nasolacrimal duct. Note that the puncta face posteriorly into the conjunctival sac, and that the eyelids move medially when the eye is forcibly closed. This moves the lacrimal fluid towards the medial angle of the eye and the openings of the puncta.

Press a finger tip on the skin between the nose and the medial angle of the eye. A rounded, horizontal

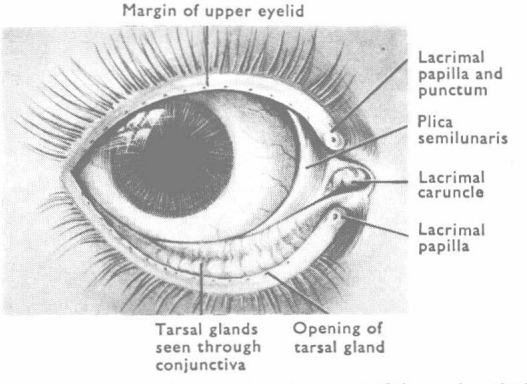

FIG. 14 Eyelids slightly everted to show part of the conjunctival sac.