The inferior surface presents four concavities, an anterior pair for the cerebral hemispheres, and a posterior pair for the optic lobes. Posteriorly the surface is much bevelled from behind, downwards and forwards, so as to rest on the supraoccipital and epiotic bones.

The *lateral plates* of the parietal run downwards and inwards; both plates begin above at about the junction of the anterior with the antero-lateral edge, and run back as far as the tubercle on the postero-lateral edge.

The external surface presents anteriorly a deep concavity which contains the lachrymal gland and a part of the orbit; and posteriorly another concavity from the upper part of which the parieto-palatine muscle arises, and from the lower portion the spheno-vomerine. A well marked ridge separates these concavities, and to this is attached the fascia covering in the lachrymal gland. The ridge if followed up is seen to end in the prominent projection above, and to this is attached a band of fascia covering the poison gland. The internal surface of the lateral plate is concave for the optic lobes. The anterior border is irregular, with splints of bone for articulation with the frontal and orbitosphenoid. A semi-circular excavation represents the posterior portion of the optic foramen. The posterior border is triangular in outline; it is rough for articulation with the prootic.

The inferior border is bevelled from above downwards and outwards, for articulation with the basisphenoid. The parietal articulates with the frontals, postorbitals, squamosals, prootics, epiotics, supraoccipital, basisphenoids, and orbitosphenoids.

The parietal differs from the bone of *Python* in not having a median ridge; it differs from all the forms examined in having the well marked lateral process.

Os Frontale.

Os Frontale, all authors.

The frontal bones are not anchylosed to one another. Each presents a horizontal and a lateral plate. The horizontal plate is quadrilateral, the antero-posterior being larger than the lateral axis. The anterior border runs from within outwards and backwards. Where the internal two-thirds joins the external third, a peculiar process of bone projects which fits into a niche in the premaxilla, which will be more particularly described later on. The external third is concave, and forms portion of the supraorbital ridge. The posterior border is convex and articulates with the parietal; it has, however, no connection with the postorbital as in *Python*. This border is bevelled from before downwards and backwards, and fits in between the under portion of the anterior edge of the temporal and of the anterior edge of the lateral plate; thus a firm schindylesis is formed. The internal edge joins its fellow of the opposite side in the mid-line, a distinct frontal suture marking the junction. Anteriorly a plate of bone projects downwards vertically and meets the lateral plate in the mid-line. Thus by the two sides joining, a vertical septum of bone is formed, which separates portion of the cerebral hemispheres. The superior surface is quadrilateral, convex and subcutaneous. The lateral part of this bone consists of a plate that runs from the middle of the inferior surface downwards and inwards, meeting its fellow of the opposite side in the mid-line, where they lie on the parasphenoid. The external surface of the lateral plate is concave and smooth, and joins with the orbitosphenoid and the anterior portion of the lateral plate of the parietal to form the large orbital fossa for the eye and lachrymal gland. A notch in the posterior border of the lateral plate is portion of the optic foramen.

The frontal articulates with the parietal, parasphenoid, orbitsphenoid, premaxilla, and nasal bones.

Os Post-frontale vel Post-orbitale.

Zygomaticum vel Frontale posterius, D'Alton; *Frontale posterius*, Cuvier, Harting, Stannius; *Post-frontale vel Post-orbitale*, Gegenbaur, Parker, Parker and Bettany; *Post-frontale*, Huxley, Hoffmann, Wiedersheim; *Schuppe des Schlafbeins*, Meckel; *Frontale posterius vel Orbitale posterius*, Joh. Müller, Owen.

The postorbital is a semilunar-shaped bone. The upper half of the external surface gives attachment to the subcutaneous tissue which supports the orbital scales; the lower half becomes twisted on itself so that it comes to be posterior. To this is attached a process of the fascia enveloping the poison gland. The upper half of the internal surface is excavated for articulation with the antero-lateral edge of the parietal; inferiorly the surface comes to be anteriorly. The superior extremity does not articulate with the frontal as in *Python*, while the inferior approaches very near to the transverse bone. This bone forms the posterior portion of the orbital margin, but does not appear to be united to the transverse bone by ligament as it is in *Python*. Its chief difference from that of the non-venomous snakes is in its superior extremity non-articulating with the frontal.

Os Nasale.

Os Nasale, all authors.

The nasals consist of two bones. Each presents a horizontal and a vertical portion. The horizontal portion is a thin plate of bone triangular in outline. Its superior surface is convex, smooth, and subcutaneous. The inferior surface is concave and forms portion of the roof of the nasal canal. The anterior border is concave and gives attachment to the olfactory capsule. The posterior border also gives attachment to the same capsule. The internal edge is ill-defined being continuous with the vertical plate. The vertical plate is a thin leaf of bone that meets its fellow of the opposite side in the mid-line. They are not anchylosed together. Posteriorly the septum formed by the two bones runs back to articulate by a pointed extremity with the frontals, while anteriorly they articulate with the premaxilla; and inferiorly they rest between the angle formed by the olfactory cartilages and the nasal septum. These bones do not differ much in shape from the bones of *Python*, but in their relations they are quite dissimilar.

In *Python* the posterior border articulates throughout its whole length with the prefrontal, while here we see that it has no connection whatever with the prefrontal. In *Pseudechis* there is a slight connection between the two bones, but in *Daboia* there is no other connection than by the membrane that bridges over the space left between the two bones. It is plain from the above arrangement that the prefrontal has a much more extended range of movement in the venomous forms than in the non-venomous.

Os Præmaxillare.

Intermaxillare, D'Alton, Cuvier, Harting; *Præmaxillare*, Gegenbaur, Huxley, Owen, Hoffmann, Parker, Parker and Bettany, Wiedersheim; *Zwischen Kiefer*, Stannius, Meckel.

The premaxilla is a T-shaped bone. The superior surface is smooth and convex, and runs upwards and backwards to form a nasal process which articulates with the vertical septum of the nasals. The inferior surface is horizontal and forms the anterior portion of the roof of the mouth. Posteriorly it is continued back to form a bifurcated palatine process. Between the inferior and superior surfaces there are small lateral plates to which the septo-maxillary bones are articulated. It contains no teeth.

The bone closely resembles the premaxilla of *Python*, and of other forms examined. The chief difference to be noticed between the bones of the non-venomous and the venomous snakes is the relation of the premaxilla to the maxilla; owing to the latter bone in the non-venomous forms being much longer it approaches close to the premaxilla and is united to it by fibrous tissue.

Os Septo-maxillare.

Ethmoideum, D'Alton, Wiedersheim; *Cornet inférieur*, Cuvier; *Turbinal bone*, Huxley, Owen; *Riechbein*, Leydig, Meckel; *Septo-maxillare*, Parker, Parker and Bettany; *Concha*, Stannius; *Septo-maxillare*, Hoffmann.

The septo-maxillary bones are two small shells on either side of the nasal septum. Each has a small vertical portion and a larger horizontal plate. The horizontal plate is triangular in outline, the base being posterior, the apex anterior, being joined to the premaxillary. The superior surface is concave, the outer portion bending upwards and inwards. It forms the floor of the nasal cavity. The inferior surface is convex and forms a roof for the nasal gland cavity of the vomer. The vertical portion is close to the septum nasi, and rests on the vertical plate of one of the vomers.

Os Vomer.

Os Vomer, all authors.

The vomers are constituted by two distinct bones, each of which has a vertical and a horizontal plate. The vertical plate of each bone approaches its fellow in the mid-line but is separated by a small amount of tissue. Above the vertical plate is in contact with the septo-maxilla and close to the nasal septum, while posteriorly the parasphenoid articulates with it.

The horizontal portion of the bone is triangular in outline, the base being at the mid-line. The anterior extremity is sharp and approaches close to the palatine process of the premaxilla. The posterior extremity is rounded and fades into the vertical plate.

The middle and external portion is convex below; it runs outwards and curls upwards, its superior surface forming the floor of the nasal gland, whose duct perforates the bone anteriorly. On the inferior surface of the bone the spheno-vomerine muscle is inserted. The nasal gland is contained in a box whose roof is formed by the septo-maxilla, the inner and inferior sides by the vomer, the external side being membranous. "Two small labial cartilages are attached to the duct of each nasal gland" (Parker).

Os Basisphenoideum.

Corpus ossis sphenoidei, D'Alton; *Sphenoideum basilare*, Hoffmann, Hallmann, Harting, Stannius; *Sphenoideum*, Cuvier, Joh. Müller, Owen; *Basisphenoid*, Gegenbaur, Huxley, Parker, Parker and Bettany, Wiedersheim; *Körper des Keilbeinstückes*, Meckel; *Körper des vorderen*, *Körper des hinteren Keilbeins*, Rathke.

Os Parasphenoideum.

Parasphenoid, Huxley, Hoffmann, Parker, Parker and Bettany; *Presphenoid*, Owen.

The basisphenoid and parasphenoid when detached from the skull together make up a triangular-shaped bone, the apex of which is anterior.

The anterior portion of the inferior surface constituted by the parasphenoid is deeply excavated, differing much from the corresponding surface in *Python*, in which there is a very prominent ridge, giving attachment to the dense fascia of the roof of the mouth. On each side of the anterior portion the spheno-vomerine muscles are placed. The unossified trabeculæ can be seen running forward from a point just below the optic foramen in a small groove on either side of the bone and just beneath the inferior portions of the frontals. The trabeculæ when traced forward are seen to "unite underneath the fore part of the frontals and become compressed into a vertical ethmoidal plate passing on into the nasal septum" (Parker). The posterior portion of the inferior surface is convex. A small ridge exists in the mid-line which gives attachment to the strong fascia of the region. On either side of the ridge is an excavated surface from which the spheno-pterygoid muscle arises. In *Python* this portion of the bone is very different. There is a very prominent median ridge, and on either side of the ridge is a large wing-like process which corresponds to the basipterygoid process of Lacertilians. A similar process occurs in *Pseudechis*. It gives origin to the spheno-pterygoid muscle. The superior surface is convex in front, but deeply excavated posteriorly to form a hollow "which contains the pituitary body, a quantity of fibrous tissue, and the internal carotid arteries which pass into it laterally beneath the parietal shelf having previously perforated the basisphenoid" (Parker). "There is a posterior clinoid wall, arching over the hinder part of the pituitary body" (Parker). Posterior to this pituitary fossa the bone is concave to receive the mid-brain. "The anterior extremity of the parasphenoid becomes compressed and knife-like, wedging in between the hinder ends of the vomers" (Parker).

The posterior extremity of the basisphenoid is broader, and from its middle point a quadrilateral outgrowth of bone springs. This is bevelled from above downwards and backwards, and is overlapped by the inferior surface of the basioccipital. The sides of the basisphenoid are bevelled from above downwards and outwards so as to articulate with the parietal above, and the prootic and alisphenoid. The parasphenoid articulates with the vomers, frontals, and basisphenoid. The basisphenoid with the lateral plates of the parietal, the prootics, basioccipital, parasphenoid, and alisphenoid.

Os Basioccipitale.

Corpus ossis occipitalis, D'Alton, Hallmann ; *Occipitale basilare*, Cuvier, Gegenbaur, Wiedersheim, Hoffmann, Stannius ; *Occipitale basilare vel inferius*, Harting ; *Basioccipitale*, Huxley, Parker, Parker and Bettany ; *Körper des Hinterhauptstückes*, Meckel ; *Occipitale inferius*, Joh. Müller, Owen ; *Grundtheil des Hinterhauptbeins*, Rathke.

The basioccipital bone is an irregular hexagon. The anterior border is vertical for articulation with the basisphenoid. The antero-lateral side is rough for articulation with the opisthotic and prootic ; it runs outwards and backwards. The postero-lateral runs inwards and backwards, and articulates with the prootic and exoccipital. The posterior border constitutes the lower portion of the occipital condyle ; below it is rounded, above it is grooved in the mid-line and bevelled from above downwards and outwards so as to receive the two processes from the exoccipital, which complete the trefoil-shaped condyle. The inferior surface is divided into an anterior and a posterior part by a transverse ridge. The anterior of the two portions has the suboccipital articular muscle attached to it. There are four spines projecting backwards from the ridge between these two portions. The median pair give insertion to the inferior part of the rectus capitis anticus of either side. The lateral pair give attachment to the superior part of the rectus anticus, which is also inserted on the posterior half of the inferior surface of the bone. The sacro-lumbalis prolonged forward from the dorsal region is also attached to the lateral spines. The superior surface is deeply excavated to receive the medulla. The basioccipital articulates with the basisphenoid, exoccipital, and prootic.

Os Exoccipitale.

Pars lateralis ossis occipitis, D'Alton; *Occipitalia lateralia*, Cuvier, Gegenbaur, Hallmann, Harting, Joh. Müller, Owen, Stannius, Hoffmann, Wiedersheim; *Exoccipitale*, Huxley, Parker and Bettany, Parker; *Gelenkstück des Hinterhauptbeins*, Meckel; *Schenkel des Hinterhauptbeins*, Rathke.

The exoccipitals are irregularly shaped bones which bound in great part the foramen magnum. Each bone consists of a superior horizontal, and a vertical lateral piece. The upper face of the superior piece is flattened and gives attachment to the spinalis dorsi, complexus, and trachelo-mastoideus. The anterior border articulates with the supraoccipital, the mesial border with its fellow of the opposite side, while the external is raised into a prominent edge to join the opisthotic, and gives attachment to some of the fibres of origin of the digastric muscle. The vertical or lateral plate presents a small tubercle for the attachment of the trachelo-mastoid, while immediately beneath this there is a second tubercle for the superior part of the rectus capitis anticus. The internal surface of this plate is in contact with the medulla. Four foramina may be seen on the surface. The anterior three lie in the same line, and transmit the ninth, tenth, and twelfth nerves; the fourth is placed superiorly and posteriorly, and is the "posterior condyloid foramen" (Parker). The anterior border articulates with the opisthotic, and slightly with the prootic, the inferior with the basioccipital, while the posterior runs downwards and backwards and goes to make up the occipital condyle by being the superior moieties of the trefoil-shaped surface. The foramen magnum is bounded almost entirely by these bones, the basioccipital supplying the lower portion only.

Os Supra-occipitale.

Squama ossis occipitis, D'Alton; *Occipitale superius*, Cuvier, Gegenbaur, Joh. Müller, Owen, Hoffmann, Wiedersheim; *Squama occipitalis*, Hallmann, Stannius; *Occipitale superius vel squama occipitalis*, Harting; *Schuppe des Hinterhauptbeins*, Meckel, Rathke; *Supra-occipitale*, Huxley, Parker, Parker and Bettany.

The supraoccipital is a very small quadrilateral-shaped bone formed by the coalescing of the moieties of the opposite sides at the mid-line; the suture can be made out. The bone runs downwards and backwards. The superior edges are closely joined to the epiotics, while the parietal rests upon them. The inferior edges articulate with the exoccipitals. The posterior surface of the bone gives attachment to the spinalis dorsi. The anterior surface helps to form portion of the cranial roof. In *Python* there is a well marked median ridge, indicating the line of junction of the opposite sides. The bone articulates with the parietal, epiotic, and exoccipital.

Ossa Periotica.

Petrosum, D'Alton, Hallmann, Harting, Müller, Wiedersheim, Rocher, Cuvier; *Felsentheil des Schlafbeins*, Meckel; *Epiotic*, *Prootic*, *Opisthotic*, Huxley, Parker, Parker and Bettany, Hoffmann, Gegenbaur; *Felsenbein*, Rathke; *Ala temporalis*, Stannius.

The periotic bones are covered in part by the anterior portion of the squamosal. On this being removed the three bones are seen united by the characteristic Y-shaped synarthrosis.

The prootic lies anterior to the other bones. It is united superiorly with the epiotic, and superior plate of the parietal, while in front it joins the posterior portion of the lateral plate of that bone. Inferiorly it rests on the basioccipital and basisphenoid, while posteriorly it is in contact with the opisthotic and exoccipital. Its external surface is perforated by the large foramen ovale, and is in relation with the alisphenoid. The fifth nerve issues from the foramen ovale in two divisions, the anterior one made up of the first and second parts of the nerve emerges in front of the alisphenoid, the posterior division behind. The small foramen for the seventh nerve is slightly posterior to the foramen ovale, while the eighth nerve emerges from a foramen placed close to the junction of the prootic with the epiotic. The bone also forms portion of the anterior boundary of the fenestra ovalis. It has the greater portion of the anterior semicircular canal running upwards and backwards to the epiotic, and it also has the anterior portion of the horizontal canal running forward to join the anterior.

The epiotic is closely united to the supraoccipital bone, and more anteriorly with the superior plate of the parietal. Inferiorly it joins the prootic, posteriorly the opisthotic. It contains the superior parts of the anterior and posterior semicircular canals. Portion of the digastric muscle arises from its external surface.

The opisthotic is in contact with the epiotic above, the prootic in front, the basioccipital below, and the exoccipital behind. It contains the chief part of the posterior semicircular canal which runs upwards and forward to end in the epiotic above. It also has the posterior portion of the horizontal canal running from the prootic in front. "The opisthotic forms the back margin of the fenestra ovalis, and forks in the fenestra rotunda nearly enclosing it" (Parker).

Os Alisphenoideum.

Alisphenoid, Parker, Parker and Bettany, Hoffmann.

The alisphenoid is a small quadrilateral-shaped line. It lies across the foramen ovale, and thus divides this orifice into two moieties. Its anterior border is concave, and forms the posterior rim of the anterior of the two orifices of the foramen ovale which transmits the first and second divisions of the fifth nerve; the posterior border bounds the foramen which transmits the third division. The superior border is joined to the prootic, while the external surface is smooth, and is in contact with the parieto-pterygoid muscle. A small foramen is present in the lower portion of this external surface; this transmits the nerve that supplies the parieto-pterygoid. The inferior border rests on the basisphenoid below.

Os Orbitosphenoideum.

Orbitosphenoid, Parker, Parker and Bettany, Hoffmann.

The orbitosphenoid is a thin plate of bone only to be distinguished with difficulty from the surrounding bones. It lies on the posterior and external portions of the lateral plate of the frontal, and articulates with the orbital portion of the parietal. It is reniform in outline, the concavity being anterior. The bone helps to form the orbital fossa, and enters by a small process into the formation of the optic foramen.

Os Squamosum.

Mastoideum, D'Alton, Harting, Joh. Müller, Owen; *Squamosum*, Gegenbaur, Huxley, Parker, Parker and Bettany, Wiedersheim, Hoffmann; *Schläfenschuppe*, Hallmann; *Zitzenknochen des Schlafbeins*, Meckel; *Tympanicum vel squamosum*, Rathke; *Squama temporis*, Stannius.

The squamosal is prismatic in outline, and presents superior, external, and internal faces.

The superior face is slightly convex anteriorly, while posteriorly it becomes narrow. The anterior portion gives origin to the posterior temporal, while the posterior portion has part of the digastric arising from it.

The external surface is convex. The anterior half gives origin to the posterior temporal; the posterior half is articulated to the quadrate by a convex facet. In *Python* it is the posterior extremity of the bone that is modified for articulation with the quadrate. The internal surface is broader anteriorly than posteriorly; its anterior two-thirds is concave for articulation with the convex facet in the epiotic. The posterior third projects backwards and portion of the digastric is attached to it. The anterior extremity abuts against the projection mentioned in connection with the postero-lateral border of the parietal.

The bone articulates with the parietal, quadrate, prootic, epiotic, and supraoccipital.

Os Quadratum.

Quadratbein, D'Alton; *Quadratum*, Gegenbaur, Hallmann, Huxley, Joh. Müller, Parker, Hoffmann, Parker and Bettany, Rathke, Wiedersheim; *Quadratum vel Tympanicum*, Owen, Stannius, Cuvier.

The quadrate is a prismatic-shaped bone with two articular extremities. The bone is twisted on its vertical axis from before outwards and backwaras. The *external* side commences in a flat oval surface above, and runs downwards and backwards to end below in an external condyle. The posterior temporal muscle arises from the upper three-fourths of the surface. The posterior side commences as a slightly concave surface above, and runs downwards and backwards, and ends below in a flattened surface. The digastric muscle arises from this surface. The internal side begins above as a broad concave surface; it runs downwards and outwards, and inferiorly coming to lie anteriorly, owing to the twisting of the bone. The external pterygoid muscle arises from this surface. There are three edges to the bone. The posterior is the only one that calls for notice. It projects forwards, and curling round forms a concave surface, to the middle of which the columella and the stylohyal are united, and it also serves to give origin to the external pterygoid muscle and the suboccipital articular muscle.

The superior extremity is prismatic in outline. The external and anterior faces are the continuations upwards of the exterior and anterior faces of the shaft of the bone. The internal face is oval, concave from before back, broader anteriorly than posteriorly. It articulates with the facet on the external surface of the squamosal, a small synovial membrane being present. The lower surface is flattened from before backwards, and presents a striking similarity to the inferior extremity of the humerus of the human body. There is a small external and internal condyle, and a trochlear surface. The external condyle is sub-cutaneous. To the internal is attached the internal pterygoid muscle, and a very strong internal ligament which unites it posteriorly to the articular bone below. The trochlear surface has its axis placed at right angles to the long axis of the head. It is the shape of an hour glass. The exterior portion is smaller and lower than the interior, since the axis of the extremity runs outwards and downwards. Both surfaces are convex from before back, while two surfaces go to make up a concavity from side to side. Each of the trochlear surfaces forms a semicircle, but the radius of the internal is to the radius of the external as two to one. Above the trochlear surface in front is a slight depression which receives the "coronoid" process of the articular.

The quadrate articulates with two bones, the squamosal, and the articular, and is in connection with the columella and stylohyal. This bone differs considerably in shape from the quadrate of *Python*. In the latter it is quadrilateral, and the inferior extremity is even broader than the superior. There is the same evident twist, but the bone is for the most part composed of an internal and external surface. The projection from the columella is also much more marked in *Python*. Comparing the size of the skull of the two snakes, the quadrate of *Acanthophis* is much more powerfully made than in *Morelia* or *Python*. In fact the quadrate is the most stoutly made bone in the head.

The Mandible.

Os Dentale, *Os Angulare*, *Os Articulare*, Harting, Gegenbaur, Hoffmann, Parker, Parker and Bettany, Owen, Wiedersheim. Os Dentale : *L'os dentaire*, Cuvier ; *Zahnstück*, Meckel ; *Dentale*, Stannius. Os Articulare : *Articulare*, Cuvier, Stannius ; *Gelenkstück*, Meckel. Os Coronideum : *Complementare*, Gegenbaur ; *Kronstück*, Meckel; *Coronoideum*, Hoffmann, Parker and Bettany, Parker; *Complementare vel coronoideum*, Stannius; *Complementare*, Owen. Os Spleniale : *Spleniale*, Parker and Bettany, Parker ; *Operculare*, Stannius, Gegenbaur, Owen, Harting, Hoffmann. Os Supra-angulare : *Supra-angulare*, Parker and Bettany, Gegenbaur, Owen, Parker, Wiedersheim; *Complementare*, Harting, Hoffmann.

The mandible is composed of two moities; an anterior single piece or dentary, and a posterior compound piece consisting of splenial, coronoid, angular, surangular, and articular. The shaft of the compound portion is bent so that the external side is convex. It has two surfaces and two borders.

The external surface runs from the dentary back to the extremity of the articular. The anterior two-thirds of it is made up of angular, and is convex; the posterior third of articular, and presents two concave surfaces and a ridge between them which runs from behind downwards and forward. The masseter is attached to the anterior two-fifths of the surface, the posterior temporal to the anterior of the two concave surfaces; between and above these muscles we have the anterior temporal inserted. The lower head of the internal pterygoid arises from the posterior of the two concave surfaces; while on the ridge between these surfaces the mylohyoid is inserted.

The internal surface is concave from before back. Anteriorly the splint-like splenial may be seen running back from the dentary, and expanding joins the coronoid; this lies immediately below the surangular no longer now to be made out as a separate element, though well seen in *Morelia*. From the posterior third of the surface the upper head of the internal pterygoid muscle arises. The middle third is convex and smooth, and over this portion the internal pterygoid glides.

As the superior edge runs back from the alveolar border of the dentary it bifurcates to enclose the large mandibular fossa into which is inserted the external pterygoid muscle. Immediately in front of the fossa the parieto-mandibularis is inserted; immediately behind is placed the sigmoid cavity of the articular, and posterior to this the edge expands into a triangular surface whereon the digastric is inserted, and over the external edge of which the retractor oris glides.

The articular surface bears a resemblance to the greater sigmoid cavity of the ulna. Its axis slopes from above downwards and inwards. A median ridge running back from a small "coronoid"-like process in front divides the cavity into two portions, each of which is concave from before back. The external portion is the smaller though deeper of the two, and serves to prevent the too ready dislocation of the jaw. The internal is large and shallow, and owing to the obliquity of the axis its excavated surface approaches much nearer the inferior edge than does the surface on the external side. The trochlear surface of the quadrate meets this sigmoid surface at an acute angle, and so, when the mandible is depressed, rotation takes place in such a way that the anterior portion of the mandible moves downwards, backwards, and outwards, thus allowing the gape to be opened to its fullest extent without dislocation of the bones.

The dentary presents an external and internal surface, a superior and an inferior edge. The bone is bent into two curves; the first portion is at right angles to the long axis of the head, the second is parallel to the long axis, at the same time having a small curve inwards so as to make the external surface concave.

The external surface runs backwards and bifurcates, enclosing the anterior extremity of the splenial. The greater portion of this surface is covered by the gland. A large mental foramen is placed close to the bifurcation.

From the inferior portion of the anterior third of the interior surface, there arises, in a well marked excavated surface, the genio-glossus muscle, and above this the genio-trachealis. Below the genio-glossus, and running along the inferior border, the inter-mandibular muscle arises.

The anterior extremity gives attachment to the intermandibular ligament.

The superior border contains about a dozen teeth. The inferior border gives attachment to the muscles as stated above.

Os Præfrontale vel Anteorbitale.

Lachrymale vel Frontale anterius, D'Alton; *Frontal antérieur*, Cuvier; *Ethmoidale laterale vel præfrontale*, Gegenbaur, Harting, Wiedersheim; *Prefrontale*, Huxley; *Præfrontale*, Hoffmann; *Thränenbein*, Meckel; *Frontale anterius vel Orbitale anterius*, Joh. Müller, Owen; *Præfrontale vel Ante-orbitale*, Parker, Parker and Bettany; *Frontale anterius vel Ethmoideum*, Stannius; *Thränenbein*, Rathke.

The anterior orbital is an irregularly shaped bone resembling somewhat the letter Z, being composed of two horizontal and one vertical piece.

The superior horizontal bar presents a superior surface flattened internally, while externally there is a notch for articulation with the projection of bone from the frontal.

The notch is formed by an excavation which runs from above downwards and outwards, at the same time extending more posteriorly below than above. The internal portion of the inferior surface of the bone is flat, and gives attachment to the posterior portion of the nasal capsule, while the external portion rests on the pedicle of the bone.

The pedicle is prismatic in outline, its axis running from above downwards and outwards. The anterior surface is quadrilateral, smooth, convex, and sub-cutaneous. The posterior surface smooth with a large foramen at its lower edge, which leads to a canal that opens on the inferior surface. This transmits the lachrymal duct. This surface bounds the orbit anteriorly.

The internal side of the prism is mainly composed of membrane, so that a cavity is formed in the bone which is in relation with the nasal canal close to the posterior nares.

The inferior plate of bone is prismatic. The pedicle rests on the internal half of its superior sides, while the outer half of the plate helps to complete the antero-lateral portion of the orbit.

The inferior surface is triangular in outline, the base of the triangle being internal. The inner portion of this surface is very slightly convex from before back, while the surface as a whole is slightly concave from side to side.

This bone shows at first sight a great difference to the corresponding bone of *Morelia* or any other python; the chief difference is in connection with the maxilla. The bone in *Morelia* occupies a more horizontal position, so that what was the anterior face of the pedicle in *Acanthophis* becomes the superior here; but, at the same time, the superior face is curved down, so that it becomes more or less antero-external, and it is the inferior border of this antero-external moiety that corresponds to the articular surface of the inferior horizontal plate in *Acanthophis*, a process forming the antero-lateral border of the orbit corresponding to the one described above. The posterior face presents a difference, in as much as it sends down processes which are united to the palatine, maxillary, and transverse bones by ligament. Owing to the horizontal position the internal border of the superior plate comes into contact with the nasals. The bones differ from those of *Pseudechis* and *Daboia* in the shape of the inferior horizontal plate. In these forms the inferior plate is convex, and forms a kind of ball and socket joint with the concave surface of the maxilla below.

Os Maxillare.

Maxillare superius, D'Alton, Cuvier; *Maxillare*, Gegenbaur, Hoffmann, Huxley, Owen, Parker, Parker and Bettany, Wiedersheim; *Oberkiefer*, *supra-maxillare*, Harting, Meckel, Joh. Müller, Stannius.

The maxilla is a crescent-shaped bone, convex externally, concave internally, and longer from before backwards than from side to side.

The superior surface is semilunar in outline, much wider in front than behind. Antero-internally it is slightly concave from before back. The inferior surface forms the alveolar margin which carries one fang firmly fixed to the bone, while two accessory ones lie embedded in the mucous membrane immediately behind. On the posterior third of this margin there are three small permanently erect teeth. The anterior surface is smooth and convex, with a small depression over the fixed fang. Over this surface the venom duct runs to reach the fang. The external surface is the continuation of the anterior; it has a small groove for the venom duct to lie in. The internal surface presents two regions, an antero- and a postero-lateral, and between them a strong process. The antero-lateral is the smaller of the two, and is formed by an excavation of the bone from above downwards and outwards; thus a concave surface is formed in which the palate bone fits. Behind this concavity the bone is produced downwards, inwards, and backwards, so that a prominent process is formed which lies on the palate, and is closely connected to that bone by ligament; the process also receives some of the fibres of the parieto-palatine muscle. The posterior two-thirds of this side is deeply excavated, forming the postero-lateral fossa. This is chiefly filled by the mucous membrane in which the accessory fangs lie.

The posterior extremity presents an articular surface consisting of a concave surface externally and a convex internally; it articulates with the transverse bone.

The bone differs from that of *Morelia*, in which the bone is long and prismatic-like, with all the teeth of nearly equal size. From *Daboia* it differs essentially in having the three solid teeth behind. It differs from *Diemenia* and *Pseudechis* only in the shape of the superior surface, which in these two forms is more concave so that the bone may move freely on the anterior orbital. Thus we see that this bone alone enables us to decide as to the classification of *Acanthophis*.

Os Transpalatinum.

Pterygoideum externum, D'Alton, Harting; *Transversum*, Cuvier, Joh. Müller; *Os transversum oder äusseres Flügelbein*, Gegenbaur; *Transversum*, Hoffmann, Huxley, Wiedersheim; *Hinteres Flügelstück*, Meckel; *Ektopterygoid*, Owen, Stannius; *Transpalatinum*, Parker, Parker and Bettany.

The transpalatine is an irregularly shaped bone, about half the length of the pterygoid. Viewed from above it is seen to be convex externally; viewed from the side the anterior half is so curved that the convexity is above. The anterior extremity is flattened from above downwards, and presents an articular head for the maxilla, the external portion being convex, the internal concave. The superior surface is convex, while a deep fossa occurs on the inferior. To the superior surface is attached a well marked band of fascia running from the postorbital bone above, which serves to bound the orbit, suspend the transpalatinum and limit its anterior movement, and lastly to form a floor for portion of the venom gland to rest on. At the junction of the anterior with the posterior half of the inferior surface, there springs a strong recurved process. To this, as well as to the posterior half of the inferior surface, the lower head of the internal pterygoid muscle is attached. The posterior extremity, as well as portion of the internal surface, articulates with the pterygoid bone.

The chief point in connection with this bone is the prominent recurved process of the inferior surface. In some lizards we have observed a somewhat similar process. It is also to be observed that the insertion of the pterygoid muscle into this bone is one of the reasons for considering that *Acanthophis* is far removed from the vipers.

Os Pterygoideum.

Pterygoideum externum, D'Alton, Harting; *Pterygoid*, Cuvier, Gegenbaur, Huxley, Hoffmann, Joh. Müller, Owen, Parker, Parker and Bettany, Stannius, Rathke, Wiedersheim; *Vorderes Flügelstück des Keilbeins*, Meckel.

The pterygoid is a scimitar-shaped bone, and thrice as long as the palatine. The anterior third is prism-shaped with its external side slightly convex, while the posterior two-thirds is flattened from above downwards, with a well marked concavity externally. The superior surface of the anterior portion of the bone gives insertion to a few fibres from the parieto-palatine muscle. The inferior surface is the alveolar border supporting a number of small recurved teeth. The anterior extremity articulates with the palate by a ginglymus joint. The posterior two-thirds of the bone is twisted on its long axis, so that the interior surface comes to lie internally, and slopes from above, downwards and inwards. To this surface is attached the pterygo-sphenoid muscle, while the parieto-pterygoid is inserted on the external border. The transverse joins the bone at the junction of the anterior with the middle half of the external border. The inferior surface is deeply excavated, and gives attachment to the internal pterygoid muscle; while a number of small teeth spring from the inner border of the surface.

The posterior extremity of the bone comes to a point, from which a ligament springs which connects the bone with the inner side of the articular. This connection is not an intimate one, and we can find no such arrangement of the extremity of the pterygoid, such as Huxley has described in *Crotalus*. This point will be dealt with below.

Os Palatinum.

Os Palatinum, all authors.

The palatine is a prism-shaped bone slightly longer than the maxilla. In the posterior half of its upper border is attached the parieto-palatine muscle. To the middle of this border the maxilla is attached by ligament. The inferior border carries five solid teeth almost the same size as those on the posterior part of the maxilla. The external border fits into the groove on the antero-lateral surface of the maxilla. The posterior extremity articulates by a ginglymus joint with the pterygoid.

The bone differs but slightly in any of the forms examined.

Hyoid Bones.

The osseous portions of the hyoid bones are represented by two thin bars which run forward on either side of the posterior portion of the tongue. They end at about an inch from the symphysis of the mandibles by converging towards the mid-line, and then coalescing below the tongue. They are hidden from view by the costo-mandibular muscles attached to their inferior surfaces, while the mylohyoid arises from them anteriorly, and the hyoglossi are attached along their internal borders. The genio-hyoglossi are inserted into their anterior portions, and the hyo-trachealis arises from the same region.

The length of the bars varies in the various species examined, being about 1½ inch in *Acanthophis*, but about 3 inches in both *Pseudechis* and *Diemenia*, so that the hyoglossi in these species do not arise from the whole length of the bones, but only from the anterior half, while posteriorly there is a special interhyal muscle developed. These bars are taken by previous writers to represent the ceratohyals of other groups.

In *Daboia*, and, to a less degree, in *Acanthophis* and *Pseudechis*, there is an arrangement which appears to throw light upon the true homology of these parts. The osseous bars run forward and converge to the mid-line, where they fuse with a small plate of cartilage (?). From either side of this plate there run out two well-marked tendinous bands which intersect the mylohyoid and the costo-mandibular muscles. Each band runs a little forward and outwards, and then turning sharply runs backwards and outwards, and is lost at the posterior extremity of the mandible. Thus we have a hyoid apparatus very similar to that described and figured by Parker for *Lacerta agilis*, and also like what we find in *Hinulia*.

Taking this view of the hyoid apparatus, we consider that the anterior intersections represent the hypohyal, and ceratohyal; the stylohyal we have seen to be attached to the quadrate. The plate at the junction of the two osseous bars will therefore be the basihyal.

The second intersection will be the first branchial bar, while the two ossified rods usually considered to be ceratohyals will be the hypobranchial bars.

The Vertebral Column.

The vertebral column of ophidians is generally divided into two regions, a costal and a caudal. Rochebrune has, however, gone very fully into the subject of the vertebræ of snakes, and he distinguishes five regions, cervical, thoracic, pelvic, sacral, and coccygeal or caudal.

The cervical vertebræ are two in number, and are devoid of ribs; they represent the atlas and axis. The thoracic and pelvic vertebræ have ribs, with ossified processes anchylosed to their lateral aspects. The caudal are distinguished by possessing a bifid hypapophysis. The only difficulty that arises is in distinguishing the thoracic vertebræ from the pelvic. The thoracic possess hypapophyses without exception; the pelvic in certain forms only. When, therefore, both regions have hypapophyses Rochebrune distinguishes between them thus:—

"*Thoracic.*—Brièveté relative du corps, surélévation et inclinaison des lames, abaissement brusque et raccourcissement des processus, direction oblique du tenon, position élevée des tubercules costaux; développement exagéré des apophyses épineuses supérieures et inférieures; largeur de la partie supérieure du trou rachidien."

"*Pelvic.*—Epaisseur et longueur relative du corps; aplatissement et écartement des lames; amincissement et relèvement de l'extrémité des processus; direction droite du tenon; position en dessous des tubercules costaux; développement des apophyses transverses; brièveté et largeur relatives de l'apophyse épineuse; brièveté et inclinaison de l'hypapophyse; aplatissement de la partie supérieure du trou rachidien."

Taking a thoracic vertebra we shall compare the vertebræ of the other regions with it.

Centrum: The centra are procoelous. The articular faces are ellipsoidal, the long axis being transverse. The edge of the "socket" is slightly concave above and below, the appearance being caused by the lateral portions projecting more forward. This has reference to the fact that the vertebræ generally move in the transverse and not in the vertical plane. The "ball" of the posterior articular surface is almost a hemisphere. On looking at the surface in profile the curve of the upper third of the ball is seen to be the circumference of a smaller circle than the lower two-thirds, while the lateral portions of the rim are produced forward so as to correspond with the lateral edges of the socket.

The centrum as a whole is somewhat pyramidal, the base being posterior. The base slopes from above downwards and backwards, and it is upon this surface that the "ball" of the posterior articular surface rests. It follows from this that the axis of the posterior face, instead of corresponding with the axis of the centrum, makes an angle of about thirty degrees with the long axis of the body. The advantage of this will be seen hereafter.

The anterior portion of the centrum corresponding to the apex of the pyramid bears the concave anterior articular face. The dorso-ventral axis of this face is inclined from before, downwards, and backwards. Owing to this the lower three-fifths of the socket rests on the front of the pyramid, while the upper two-fifths is free, and inclines forward. The reason for this becomes evident when we take a longitudinal vertical section of two vertebræ; we then see that the superior part of the cup rests on the upper and most curved portion of the ball, while the lower three-fifths rests on the less curved portion of the ball. We thus have a ball and socket joint, the dorso-ventral axis of which is downwards and backwards, and thus is formed a joint capable of withstanding greater force from above downwards than if the axis of the ball and socket was parallel to the long axis of the body.

From the anterior portion of the external surface the diapophysis and parapophysis spring; while from the inferior surface a strong recurved hypapophysis projects. On each side of the base of the hypapophysis are seen two excavations from which the levatores costarum interni spring. The superior surface forms the floor of the neural canal.

Pedicles: The pedicles arise from the lateral portion of the superior surface of the centrum. They are very short auteriorly, but longer behind, and run upwards and slightly outwards. The external surface is grooved for the subvertebral rectus muscle, while anteriorly the buttress of bone supporting the prezygapophysis springs from its side. The anterior and posterior edges are indented forming portions of intervertebral notches for the exit of the spinal nerves. Where the posterior portion of the pedicle joins the lamina the postzygapophysis is given off.

Laminæ: The laminæ run upwards and inwards from the pedicles to the mid-line; at the same time they are produced forwards and backwards to form the zygosphene and zygantrum respectively. The external surface of the lamina is excavated for the rotatores dorsi muscles. The anterior edge is taken up by the zygosphene; the posterior is well marked and runs outwards into the posterior edge of the first zygapophysis, while it is continued internally into the neural spine.

Neural spine: The neural spine springs from the junction of the laminæ in the mid-line. It is quadrilateral in outline. The edge is sharp, and the tendons of the spinalis dorsi are inserted on it. The anterior edge is likewise sharp, and gives attachment to the interspinales. The posterior edge is marked by an excavation in which the interspinales lie. The lateral sides of the spine are broad and smooth, and from here the spinalis dorsi and multifidus spinæ arise, the former above, the latter below.

Zygosphene: The zygosphene projects from the anterior borders of the laminæ as a well marked process. The superior surface is convex, and gives attachment to a strong ligament which helps to bind the vertebræ together. The lateral surfaces are bevelled from above, downwards and backwards, forming facets for articulation with the preceding zygantrum.

Zyantrum: The zyantrum is formed by the expansion of the laminæ posteriorly. It presents two facets, which will be understood by supposing a pyramidal piece to be excavated from the internal face of the posterior portions of the diverging laminæ. The excavation is made from above downwards and outwards, but the floor runs downwards, inwards and backwards. Into this niche on either side a facet of the zygosphene fits, " like the joints called tenon-and-mortice in carpentry " (Owen).

Prezygapophysis : The prezygapophysis is supported on a pedicle of bones that runs upwards from the diapophysis. The articular face looks upwards, is oval, with a process from its anterior border. It runs downwards, inwards, and backwards. It articulates with the posterior zygapophysis of the preceding vertebra. The pedicle that supports the zygapophysis sends up a well-marked process external to the articular facet. This we consider to be a metapophysis. It gives attachment to the levatores costarum, longissimus, and intertransversarii muscles.

Postzygapophysis : The postzygapophysis is not so strongly built as the anterior, the reason being that the anterior is the supporting zygapophysis.

The articular facet is situated on the inferior surface, and consequently looks downwards, while at the same time it runs inwards, forwards, and slightly upwards, a small projection proceeding backwards from its posterior edge.

The superior surface of the zygapophysis is flattened, and is continuous with the external surface of the lamina. To this is attached the semispinalis.

Transverse Process : The transverse process is represented by a small projection of bone from the external side of the anterior portion of the centrum. On this projection an articular face is developed which is made up of two tubercles. The superior tubercle projects outwards, is rounded, convex, and more posterior than the inferior, which is oval, slightly convex, and larger than the superior. Between the two tubercles there is a depression, concave from above downwards. The axis of the whole articular face is downwards and forwards. Leading from the inferior tubercle is a small pedicle of bone ; this runs forward and downwards, and is regarded by Owen as representing a parapophysis.

Hypapophysis: The hypapophysis springs from the whole of the inferior edge of the centrum. It runs downwards and backwards. Its anterior edge is longer than its posterior, and slightly concave from above downwards. The external sides are rounded, and give attachment to the depressores costarum and subvertebral rectus.

Atlas: The atlas presents as in all vertebrates the most considerable modifications. The anterior face has three articular facets, while occupying the region of the centrum is the elliptical prominence of the anterior extremity of the odontoid process. Anteriorly and inferiorly this latter slopes rapidly downwards and backwards, while superiorly it extends upwards and backwards for a short distance only. On either side it meets the lateral facets of the atlas at an acute angle. These facets, which represent the articular surfaces of the lateral masses, spread out from the odontoid process like wings ; they are triangular (the apex being superior) and concave. Each plate is placed so that its surface slopes downwards, backwards, and inwards, to meet the odontoid process, and thus, as mentioned above, an acute angle is formed on either side. The facets articulate with the exoccipital moieties of the trefoil condyle of the skull. The third face is the superior surface of the autogenous hypapophyseal portion of the bone. It is pentagonal in shape, the apex being in front. The surface is concave and lies anterior though inferior to the odontoid process, which it meets behind, making with it an angle of 60°. The anterior portion of this face presents a distinct ridge, which enables the occipital condyle to hook on most effectually. The neural arch is formed by two curved laminæ of bone running up to meet in the mid-line, the neural canal being wider, though less high, than in other regions. The neural spine is absent, a slight ridge taking its place. There is no prezygapophysis or zygosphene; the anterior superior edge being, however, in close relation to the posterior superior edge of the exoccipitals. A small prezygapophysis is present, but no facets for a zygantrum, the posterior border projecting slightly over the axis, which has no zygosphene. Two small tubercles project from a weakly developed transverse process. The hypapophyseal region consists of a wedge-shaped piece of bone, the anterior portion of the superior surface of which was described above. It articulates with the inferior surface of the basioccipital portion of the condyle of the skull; it is also in contact with the odontoid process, and with the hypapophysis of the axis. A suture shows its autogenous separation from the atlas upon which it is freely movable.

The posterior articular surface of the bone presents two concave lateral facets, and a concave inferior façet. These all articulate with surfaces on the axis.

The various elements fit on to the occipital condyle in the following manner. The superior portion of the tubercle carries ligaments, while the anterior and inferior part fits into the V cleft formed by the exoccipitals on either side, and the basioccipital below. The lateral concave wings fit on the exoccipital; the small convex portion mentioned above fits in between the latter bone and the basioccipital. On the surface of the concave pentagonal plate of the hypapophysis, the convex surface of the basioccipital rests; and since the inferior edge of this bone is produced into a hook-like process, this fits into the ridge of this pentagonal plate.

Thus it can be seen that lateral movement of the head can take place to a degree; while upward movement is rendered almost impossible by the close apposition of the bones. On the other hand downward movement can take place to a considerable degree.

Axis: The odontoid process is represented by a sub-conical projection proceeding forward from the centrum. Three articular facets surround its base, the upper ones articulating with the lateral surfaces of the atlas, the inferior with the hypapophysis. The pedicles are short and straight, while the laminæ are quadrilateral, their antero-posterior and lateral measurements being equal. The neural spine is short and conical, and the neural canal is more rounded than in the case of the atlas. There is a weakly developed anterior zygapophysis and a well developed posterior one. A short recurved spike of bone, springing from the transverse process, is in serial homology with the ribs. The anterior surfaces of the laminæ are not formed into a zygosphene, but there is a zygantrum developed posteriorly. The hypapophysis presents a reduplicated arrangement, for closely united to the hypapophysis of the atlas is seen a small process of bone separated by a suture from the odontoid above. This is followed immediately by a well marked recurved spine, the true hypapophysis. The anterior of the two processes appears in all the snakes examined, and is also well developed in *Grammatophora*; while in the atlas of man a well marked nodule of bone may be sometimes observed in this situation. The third vertebra was remarkable in having no ribs attached to it; a small process of bone, anchylosed to the transverse process, being the only representative of a rib.

On considering the spinal column as a whole, we find that it is composed of two pyramids placed with their bases opposed to one another. In this it agrees with the observations of M. Rochebrune, who says, after examining a great number of skeletons of snakes, " On observe que l'axe osseux est formé de deux pyramides étroites sensiblement pentagonales, opposées par leur base la plus large, plus au moins longues en raison des os qu'elles renferment, et dont la première depasse rarement les trois huitièmes de la longueur totale du corps." The vertebræ number about 175; the exact number is difficult to ascertain, since the last fifteen are but thin leaves of bone. Of this number 124 vertebræ bear ribs.

The only points to be noted in connection with the first ten vertebræ are that they are relatively small, and that the neural spine, instead of springing from the whole line of junction of the laminæ, arises from the posterior portion only, and running upwards is constricted so that it appears somewhat hour-glass shaped when viewed from the side.

The hypapophysis is also longer and less oblique, and at the same time weaker than it is more posteriorly. Gradually, as we continue back, we find the neural spine becoming broader antero-posteriorly, while the hypapophysis becomes shorter, and slopes downwards and backwards. The vertebræ as a whole become more stoutly made until we reach the fiftieth, which constitutes the base of the anterior pyramid. From this onwards we have the vertebræ decreasing in size, the neural spines becoming shorter, and springing from the whole length of the line of junction of the laminæ, while the hypapophyses also become shorter and more pointed. At the 126th vertebra we have the ribs ceasing, and in their place we now get two processes the exact nature of which has caused much discussion.

If we examine the vertebræ from this point to the 132nd we shall find that these processes spring from the transverse processes, the superior one arising from the upper tubercle, the inferior from the lower tubercle. A few vertebræ further back we have the superior process disappearing, and represented by a small projection only, from the surface of the inferior one; the appearance presented being similar to the letter ⋖. Still further back the superior process disappears entirely. At the vertebra where the ribs cease we have frequently a well-marked rod of bone, anchylosed to the superior portion of the rib, and freely movable by its inner extremity on the superior tubercle of the transverse process. This occupies such a position as the superior of the two processes mentioned above. It is to be noted that when this occurs we do not find the tubercle of the rib present.

Many conjectures have been hazarded as to the real nature of these processes. Rochebrune says, "Contrairement à l'opinion de Meckel ces apophyses ne sont pas dues à une bifurcation de la côte, la superieure est constituée par la pleurapophyse modifiée et soudée au centrum; l'inferieure est due au développement exagéré de la parapophyse, interprétation vers laquelle penche R. Owen." Owen says, "The diapophyses become much longer in the caudal vertebræ and support in the anterior ones short ribs, which usually become anchylosed to their extremities." Hoffmann says, "Ganz eigenthümlich ist die Erscheinung, dass wort wo die præsacralen Wirbel in die postsacralen übergehen, die Rippen und die Processus costo-transversarii eine Gabelbildung zum Schutz der Lymphherzen bilden. Salle, welcher sich mit ihrem Bau ausführlicher beschäftigt hat, nennt dieselben, "Lymphapophysen," und je nachdem die Gabelbildung an den Rippen oder an den Processus costo-transversarii (Querfortsätz, Salle) vorkommt "costale" oder transversale costo-transversale." And again, "Was die Entwickelungsgeschichte der Lymphapophysen angeht, so theilt Salle mit, dass beide Schenkel gleichzeitig von einer gemeinsamen Basis auswachsen, Knorpelig angelegt werden und später ossificiren." In endeavouring to account for the homology of the parts we are met with this difficulty. If we take Salle's observation as correct, both processes spring from the one point, then the process that is in connection with ribs must either represent both processes coalesced into one and differentiated off from the vertebræ, or else it contains only the representative of one of the processes; or thirdly, that it has no connection with either of the posterior elements. If we were to suppose that the rib was an outgrowth from the side of the vertebra, our difficulty would then vanish, for we would then have two processes springing from the vertebra in each case, but being differentiated off in the one instance, and remaining attached in the other. To this it must be said that all late investigations tend to show that the ribs are not an outgrowth from the vertebræ, but are formed quite independently. The question arises, can even development prove the homology of the process attached to the ribs? We doubt if it could; for were it to be shown that the process arose independently of the vertebra, then the objection remains that the posterior ones are outgrowths from the vertebræ. And if, on the other hand, the process arises as an outgrowth like the posterior one, then which of the two does it represent?

The fact seems to be clear, that, as regards the actual position of the two processes, the superior corresponds to the detached process connected with the rib, while the inferior corresponds to the rib itself. If this be so then we think that the following statement by Flower may throw some light on the subject:—

"There can be no doubt, but that an autogenous process of one vertebra of an animal may be serially represented by an exogenous process in another vertebra of the same animal; and likewise that the corresponding processes of the same vertebra may be developed exogenously in one animal and autogenously in another."

In dealing with the prezygapophysis above, we suggested that the process connected with it might represent a metapophysis, and we now suggest that the superior of the two processes may be an anapophysis, while the inferior may represent the lumbar transverse process of higher animals.

From the 133rd vertebra to the end we have considerable alterations. The elements of the vertebræ begin to diminish in size, and at the same time the hypapophysis becomes bifid. Rapidly the processes become less conspicuous, so that when we reach the last fifteen vertebræ we find a neural arch formed by the diminutive laminæ supporting a thin perpendicular spine, while inferiorly the hypapophysis is represented by two small spicules of bone only.

In comparing the vertebral column of *Acanthophis* with that of *Pseudechis* and *Diemenia*, we see no very marked difference. The processes from the prezygapophysis are more conspicuous, and the neural spines are not so high in these two forms. The greatest dissimilarity exists in regard to the tail vertebræ which are more stoutly made, and exhibit the same processes as the anterior, only less well developed. As compared with *Morelia* the zygantrum of the latter is much more excavated, the articular surfaces on either side being separated anteriorly only by a slight ridge of bone in the mid-line. In the second place there are no processes (metapophysis?) springing from the prezygapophysis, a slight ridge below the articular head being the only representative; neither are there any inferior processes from the lower portion of the transverse processes.

Perhaps the most striking difference arises in the connection with the hypapophysis. In all venomous snakes that we have examined there is a well-developed hypapophysis on all the vertebræ that bear ribs, but in non-venomous forms the hypapophyses cease to be developed at a variable distance from the anterior extremity. In the following table we show how variable the processes are :—

	Vertebræ.	Ribs.	Hypapophyses.
Morelia	363	273	78
Python sp.	340	259	69
Zamensis carbonarius	310	195	38
Boa constrictor	305	?	60
Python tigris	291	251	74
Deurodon scaber	256	?	32
Crotalus horridus	194	168	194
Acanthophis	175	124	175

Soon after the ribs cease the hypapophyses again appear, but in a bifid form. The nature of the hypapophysis has called forth much discussion, and Rochebrune has made the following remarks concerning the subject :—

" Les anatomistes attribuent à l'hypapophyse un rôle importan, dans le mécanisme des mouvements, et tout en la considérant comme destinée à servir d'attache aux muscles fléchisseurs du tronct ils n'hesitent pas à voir en elle un obstacle à la flexion du corps en dedans. . . . Pour faire voir que l'influence de l'hypapophyse, comme obstacle à la flexion en avant, est de nul effet, il suffit de renvoyer à ce qui à été dit au sujet des espèces dendrophyles, à longues hypapophyses malgré leur mobilité excessive, et aux descriptions des hypapophyses longues, droites et minces des genres Python, Boa, etc." Rochebrune then goes on to say that he considers them of only secondary importance as regards muscular attachment. He supposes that the hypapophyses play an important part in the ingestion of the prey. " La longuer de la ligne hypapophysaire dépasse rarement celle de l'œsophage et de l'estomac ; l'une et l'autre sont en rapports directs, de telle sorte qu' à l'inspection d'une colonne rachidienne, il est possible de determiner l'étendue des deux organes." He sums up by saying, " Les hypapophyses nous semblent donc être destinées, tout particulièrement, à maintenir le bol alimentaire pendant les contractions que nécessite l'acte de la déglutition, et à faciliter son cheminement à travers le canal alimentaire."

After examining the subject attentively we certainly reject the suggestion of Rochebrune with regard to the processes hindering the regurgitation of the food. We do not hesitate to say, that had such been the case "selection" would in time have brought about a much more efficient mechanism than at present exists in the poorly developed hypapophyses of non-venomous snakes. In *Deurodon* alone have we not an example of how efficiently "selection" will act when called upon? We prefer to adhere to the view that the hypapophyses are developed to give attachment to muscles. The question therefore arises, why should the hypapophyses disappear in some species and not in others? The only explanation we can give is that the hypapophyses are developed not only in snakes, but also in the higher animals in the cervical and caudal regions, while less commonly in the lumbar region; and that along with the appearance of the hypapophyses we have well marked hypaxial muscles developed. In the snake, while the hypaxial muscles are developed throughout the whole column, yet we have anteriorly the conspicuous bundles of the rectus capitis group calling for much more extensive bony attachment than could be afforded by the vertebræ without hypapophyses. In the venomous snakes we find that the hypaxial muscular bundles do not flatten out as in the non-venomous species, and this may be the reason why we should always find greater processes. And going a step further we say that the muscles remain more rounded in order to act most efficiently, by aiding the rapid movements which characterise venomous snakes.

The Ribs.

The rib consists of a shaft and two extremities. The inner or vertebral extremity presents for examination an articular surface and a well marked process. The articular face is reniform, the concavity being anterior. Its superior portion is concave, and articulates with the upper facet of the transverse process of the vertebra, while its inferior portion is slightly convex, and glides over the surface between the two facets of the transverse process. The process springs from the upper portion of the extremity, and is continuous with the posterior surface of the shaft. It runs upwards and backwards, and gives attachment to the innermost bundles of the external intercostal muscles; while the superior vertebro-costal ligament, running forwards and outwards round the superior surface of this process, thus prevents rotation forward of the upper and inner portion of the rib.

The Shaft: The shaft is prismatic in shape and presents an anterior, posterior, and inferior surface, together with three borders.

Anterior surface: To the upper portion of the inner third of the anterior surface are attached the levatores costarum externi; while to the lower portion of this inner third and to the whole of the outer two-thirds are attached the external intercostals.

Posterior surface: The posterior surface, (which if continued internally would end in the process described above) gives attachment to the external intercostals.

Inferior surface: The inferior surface is more rounded than the preceding ones, but it is not well defined from the posterior surface, except internally. The external intercostals arise from here as well as from the posterior surface.

There are three borders, a superior, anterior, and posterior.

Superior border: The accessory portion of the sacro-lumbalis column arises at the junction of the inner two-fifths with the outer three-fifths; while immediately external to this we have the sacro-lumbalis inserted, and the pretrahentes costarum superiores, and the external oblique arising. The pretrahentes superiores cover the middle third, and are inserted at the junction of this with the outer third over which the pretrahentes inferiores run.

Anterior border: The anterior border when followed inwards is seen to end in a tuberosity which gives attachment to the levatores costarum interni, and the inferior vertebro-costal ligament. The outer third of this border gives origin to the retrahentes costarum.

Posterior border: The posterior border gives insertion to the depressores costarum. At its middle point, and just external to this, we have the origin of the transverse muscle, and still more external the insertion of the retrahentes costarum. The external extremity gives attachment to the costal cartilages, which give origin to the internal oblique, and the antero-posteriorly directed fibres of the external intercostal muscles.

Myology.

Muscles of the Head.

On the integument being reflected from the cephalic region the muscles of the head are displayed covered only by a delicate fascia, which runs forward to be lost on the frontal bones. In the mid-line the greater portion of the median triangle of the parietal bone is to be seen uncovered by muscle. On either side anteriorly lie the masseters resting on the venom gland beneath, and covering the anterior, and portion of the posterior, temporal muscles. Posteriorly the quadrilateral-shaped digastric runs outwards and backwards to the extremity of the mandible, where it is covered by the fibres of the retractor oris as they run from the neural spines downwards and forwards to end at the symphysis of the lips. Inserted on to the supraoccipital is seen the spinalis dorsi, while on the exoccipital of either side is the complexus. Posterior to the retractor oris the depressor mandibulæ springs, and runs forward and downwards to merge into the mylohyoid between the mandibles below.

Masseter.

M. parietali-quadrato-mandibularis (seine vordere Portion), Hoffmann; *Schliesser des Mauls oder Beissmuskeln*, Hübner; *Der grosse Beiss- oder Shläfenmuskeln (seine vordere Portion)*, D'Alton; *M. temporalis*, von Teutleben; *Masseter*, Owen; *Temporalis anterior*, Duvernoy, R. Jones.

The masseter arises from the lower two-thirds of the external surface of the postorbital bone, and from the upper portion of the lateral triangle on the superior surface of the parietal. The muscle is in two parts. The superior or superficial portion arises mainly from the parietal, and its fibres run downwards and backwards to become inserted by a tendon on the posterior part of the superior surface of the capsule of the venom gland ; at the same time some of the fibres are inserted more anteriorly. The deeper portion of the muscle arises in great part from the postorbital, and runs downwards and backwards to form the internal fibres of a band of muscle which arises from the internal aspect of the capsule of the gland. The muscle turns round the commissure of the lips, and runs forward to be inserted on to the anterior two-fifths of the external surface of the articular moiety of the mandible, immediately behind the dentary.

The muscle is thus seen to be composed of three portions, and in this respect it agrees with the description given by Duvernoy (5) of *Naja* and *Bungarus*. In *Pseudechis* and *Diemenia* the arrangement is very similar, there being, however, more muscular fibres inserted on the gland anteriorly. In *Morelia* the upper portion of the muscle is represented, its fibres run downwards and backwards, and end in a tendinous expansion which is inserted on the mandible for a short distance. The muscle is, in this latter snake, and the same seems to hold good for all the *Colubridæ*, in relation with the large lachrymal gland, and gives fibres to it to form a special compressor. D'Alton describes this muscle as arising by two heads in *Python bivittatus*.

In *Daboia* the masseter is but slightly attached to the parietal bone ; it arises chiefly from the superior surface of the capsule of the gland, and runs downwards and backwards so as to be more posterior to the gland than in the *Elapidæ*. This seems to be the typical manner of origin of the masseter in vipers.

Posteriorly the masseter is related to the posterior temporal muscle, while on reflecting it the anterior and deep temporal come into view together with branches of the fifth nerve, one of which supplies the muscle. The muscle acts as an elevator of the mandible and compressor of the venom gland, and of the lachrymal gland in colubrine snakes.

M. TEMPORALIS ANTERIOR.

Zweite mittlere Portion of No. 1, D'Alton, Hoffmann; *M. temporalis*, Owen; *Middle temporal*, Duvernoy, R. Jones.

The anterior temporal arises from the outer portion of the lateral triangle of the parietal, and from a small part of the superior surface of the prootic. The anterior fibres running backwards and the posterior forwards, meet, and together they descend over the rounded anterior portion of the squamosal, and running back are inserted into the superior edge of the middle third of the mandible above and behind the insertion of the masseter.

The muscle is well developed and of considerable size in *Acanthophis*, *Diemenia*, and *Pseudechis*; while in *Morelia* it is a very powerful muscle, occupying a great portion of the postorbital fossa. In *Daboia* it is however of small size, and is represented by a band of muscle which arises from the side of the parietal, and running outwards and downwards comes to be anterior and external to the insertion of the masseter.

The anterior temporal is covered by the masseter and part of the venom gland, while it is closely related to the branches of the third division of the fifth nerve, which emerge far under its anterior border. Behind it is closely related to the posterior temporal and external pterygoid, while internally it covers in the parieto-pterygoid and parieto-palatine muscles. It is supplied by the fifth nerve.

Its action is to raise the mandible; in *Python* it is the chief muscle in this action. It depresses the cranium when the mandible is fixed.

M. TEMPORALIS POSTERIOR.

Dritte Portion of No. 1, D'Alton, Hoffmann; *Posterior temporal*, Owen, Duvernoy, R. Jones.

The posterior temporal arises from the upper three-fourths of the external surface and edge of the quadrate. Its fibres run downwards and forwards to be inserted into the ridge, and the excavated area on the middle third of the external surface of the surangular plate of the mandible, having the insertions of the masseter and anterior temporal anteriorly, and the mylohyoid inferiorly.

The muscle is related to the digastic posteriorly, while some fibres of the retractor oris spread over it externally. Internally the muscle hides from view the external pterygoid.

The muscle differs but slightly in all the forms examined. It is supplied by the fifth nerve. Its action is to raise the mandible, or when the latter is fixed to depress the cranium.

M. PARIETO-MANDIBULARIS (muscle of the epipterygoid bone).

Die vierte Portion of No. 1, Hoffmann, D'Alton.

On reflecting the masseter and pushing aside the venom gland, a thin rounded muscle is observed lying in front of the anterior temporal muscle. It arises from the prominent projection at the junction of the middle-lateral with the posterior-lateral edge of the parietal bone. It runs downwards and backwards to be inserted on a small area of the upper portion of the middle third of the internal surface of the mandible. The muscle was described by D'Alton, who took it to be a portion of the temporal muscle (tiefste Portion). Hoffmann has likewise described it as portion of the temporal. An important relation is established by a large branch of the third part of the fifth nerve, which emerging from under cover of the anterior temporal muscle winds round this muscle, and separates it from the temporal group.

In *Hydrosaurus* a similar muscle is present, springing from the parietal, and the superior portion of the epipterygoid (columella) and being inserted on to the mandible. The nerve has the same relation to it as in the snakes. The muscle appears in all the snakes examined, and Sanders (No. 25), has described a muscle similar to this in *Platydactylus* and *Liolepis*. He however says that the muscle is inserted into the pterygoid bone; this we think is a mistaken observation. He suggests that the muscle corresponds to the tensor tympani, but we are at a loss to see on what ground he could found his homology. It may belong to the temporal group, but the relation of the nerve to it forms an obstacle to its being considered so. On the other hand it is supplied by the third division of the fifth nerve.

It is interesting to find this muscle in the ophidians from its relation to the columella in the lacertilians, since we see the bone disappearing, but the muscle remaining to aid as an elevator of the mandible.

M. PTERYGOIDEUS EXTERNUS.

Part of posterior temporal, Hoffmann, D'Alton, Owen, Jones, Duvernoy.

On the posterior temporal muscle being removed, the fibres of the external pterygoid are displayed, arising from the whole of the anterior edge and part of the internal surface of the quadrate; the muscle runs downwards to be inserted into the whole of the mandibular fossa. The muscle is separated from the posterior temporal by fascia, and by the inferior dental nerve which winds round its anterior edge to gain the external surface, where it runs to enter the foramen on the mandibular fossa. The muscles presented no differences in any of the snakes examined. The muscle is usually regarded as part of the posterior temporal, and no previous observer has described it as being at all separated from the posterior temporal. Whatever be the proper homologue of this muscle it must certainly be described as being quite distinct from the posterior temporal. We think it approaches more closely to the external pterygoid than the muscle usually described under that name. It is supplied by the third division of the fifth nerve.

M. PTERYGOIDEUS INTERNUS.

M. tranverso-maxillo-pterygomandibularis, Hoffmann; *Aeussere Flügelmuskel*, D'Alton; *Pterygoideus externus*, von Teutleben; *Pterygoideus externus et internus*, Duvernoy and R. Jones; *M. ektopterygoideus et M. entopterygoideus*, Owen.

The internal pterygoid arises by two heads. The external or inferior head springs from the lower portion of the external surface of the posterior two-thirds of the mandible. The inner head arises from the lower part of the posterior third of the inner face of the mandible, and from the capsule of the quadrato-mandibular joint, and from the inferior extremity of the quadrate bone. The two heads coalesce into a rounded belly of muscle which runs forward and downwards, the lowermost fibres being inserted on to a special process in the middle of the inferior surface of the transverse bone, and also into the posterior half of that bone. The upper fibres, (or those that mainly spring from the internal surface of the mandible), are inserted into the inferior surface of the posterior half of the pterygoid bone. The muscle at its origin has the digastric above it externally, while the spheno-pterygoid lies on the internal face. Inferiorly the muscle is completely covered by the mylohyoid.

The muscle is usually described as two, *i.e.*, the external and internal pterygoids. We have carefully dissected several forms to ascertain if there are any grounds for this separation, and we find that the separation into two muscles is quite unnecessary. The same holds good for *Hydrosaurus*. We may also add that the same nerve supplies both parts of the muscle.

In *Daboia* and in all vipers the muscle is prolonged forward so as to be inserted into the maxilla, and at the same time sending a tendon to act on the mucous membrane that covers the fangs. This arrangement of the pterygoid muscle forms a valuable means of distinguishing the vipers from the venomous colubrine snakes. The insertion of the muscle in *Acanthophis* into a special process on the transverse bones is interesting, as a similar process for its insertion is seen in *Hydrosaurus*.

M. DIGASTRICUS (Posterior belly).

M. occipito-quadrato-mandibularis, Hoffmann; *Niederzieher des Unterkiefers*, D'Alton; *M. temporalis*, von Teutleben; *M tympano-manibularis*, Owen; *M. digastricus*, R. Jones, Duvernoy.

The digastric arises by two distinct portions. The smaller one springs from the ridge between the supraoccipital and the epiotic bones, and from the posterior third of the superior surface of the squamosal; the larger portion arises from the posterior surface of the quadrate, and from the capsule of the joint between the quadrate and the squamosal. The bellies coalesce above and run downwards and backwards to be inserted into the whole of the triangular area on the upper surface of the articular, immediately behind the quadrato-mandibular articulation. The two bellies are more distinct in *Morelia.* They also appear to be well marked in *Crotalus durissus* as figured by Duvernoy.

The muscle is supplied by the seventh nerve.

Its lower portion is covered externally by the fibres of the retractor oris. It is the chief muscle in opening the mouth of the snake, since it acts on the posterior extremity of the mandible, raising it and so depressing the anterior portion.

M. PTERYGO-SPHENOÏDALIS (Levator palati).

M. pterygo-sphenoidalis posterior, Hoffmann; *Innere hintere Flügelmuskel,* D'Alton; *Spheno-pterygoid,* Duvernoy, R. Jones; *Prespheno-pterygoideus,* Owen.

The pterygo-sphenoidalis arises from the lateral surface of the parasphenoid bone as a narrow strip of muscle; this runs backwards and is continuous with a broader belly which arises from a special excavation on the basisphenoid, close to the median line. The muscle runs downwards, backwards, and outwards to be inserted on the superior surface of the posterior half of the pterygoid bone. At its origin the muscle has the spheno-vomerine muscle lying externally, while the parieto-pterygoid lies externally at its insertion. The muscle is hidden from view by the aponeurosis that covers the roof of the mouth.

According to Owen it represents the levator tympani of fishes. We, however, regard it as the levator palati for the reasons given below.

The muscle is one of the most powerful of the head group, and is the chief protractor of the pterygoid bone, and hence the chief erector of the fang.

M. PTERYGO-PARIETALIS. (Part of tensor palati).

M. pterygo-parietalis, Hoffmann; *Der Hebemuskel des inneren Flügelbeins,* D'Alton; *M. orbitalis,* Hübner; *M. post-orbito-palatine,* R. Jones; not mentioned by Owen.

The pterygo-parietalis arises from the anterior portion of the postero-lateral edge of the parietal, and from the lateral plate of the parietal immediately below. It runs downwards, backwards and outwards, to be inserted on the middle third of the external edge of the pterygoid bone, and slightly into the posterior extremity of the transverse bone. As the muscle passes backwards it is closely connected with the external face of the spheno-pterygoid muscle; while the anterior temporal and parieto-mandibular muscle, together with the branches of the fifth nerve, cover it externally.

The muscle is very large in *Daboia* and arises more anteriorly than in *Acanthophis*.

Cuvier regarded the muscle as a dismemberment of one of the temporal group. From the relations of the nerve trunks to it, we consider that it has no connection whatever with the temporal muscles, and, as shown below, we believe it to be a specialised tensor palati. The nerve of supply emerges behind the fifth, from a foramen in the lower part of the alisphenoid, and occupies such a position as the nerve for the otic ganglion does in the higher animals.

The muscle acts as a protractor of the pterygoid bone, and therefore as an erector of the fangs.

M. PARIETO-PALATINUS (part of the tensor palati).

M. pterygo-sphenoidalis anterior, Hoffmann ; *Innerevordere Flügelmuskel*, D'Alton ; *M. palatinus*, Hübner ; *Prespheno-palatine*, Owen ; *Spheno-palatine*, Duvernoy, R. Jones.

The parieto-palatine muscle arises from the posterior concave surface on the lateral plate of the parietal bone, and runs forwards, downwards, and outwards, to be inserted on a small portion of the pterygoid, and on to the posterior two-thirds of the palatine bone. Some fibres may be traced to the mucous membrane surrounding the fangs, here performing the office of retractors of the membrane. The muscle lies at its origin between the parieto-pterygoid and the pterygo-sphenoid muscles, and as it runs forward it comes into relation with the fascia covering the lachrymal gland.

It is this muscle which acts slightly on the gland in venomous serpents, while it is the masseter in the non-venomous. This muscle is supplied by the same nerve as the parieto-pterygoid, and we regard it as part of that muscle. In *Diemenia* there is essentially but one muscle. We have changed the title of spheno- to parieto-palatine, since the muscle arises wholly from the lateral plate of the parietal in all the venomous forms that we have examined; while in *Morelia* it arises lower down, but even here but few fibres are attached to the basisphenoid. In *Python*, according to D'Alton, the muscle arises in great part from the basisphenoid. The muscle in *Daboia* arises more anteriorly than in *Acanthophis*, so that it comes to lie more in the orbital fossa.

The muscle retracts the palatine and pterygoid bones, and also, as mentioned above, acts on the mucous membrane of the fangs in the *Elapidæ*; this action being performed by the pterygoid in the vipers.

M. VOMERO-SPHENOIDEUS.

M. vomero-sphenoideus, Hoffmann; *Zuruckzieher des Vomer*, D'Alton; *M. sphéno-vomèrien*, Dugès and Duvernoy; *Prespheno-vomerine*, Owen, and R. Jones.

The vomero-sphenoideus is a small muscle displayed on removing the fascia from the roof of the mouth. It arises as a small belly of muscle from a depression on the lateral plate of the parietal, close to the basisphenoid. The muscle runs forward beneath the trabeculæ cranii, and ends in a very fine tendon which is inserted on the posterior end of the vomer.

The muscle appears to be a differentiated portion of the pterygo-sphenoideus. Its action is to depress and retract the premaxilla through acting on the vomer.

Some authors have stated that they consider the muscles connected with the pterygoid and palatine bones of the snake to have no analogues in other animals. The muscles certainly present an extremely different aspect and function to the palate muscles; yet when we consider the extreme modification that the bones have undergone, we cease to wonder at thc change in the soft parts. We consider that the parieto-pterygoid represents the tensor palati; while the spheno-pterygoid represents the levator palati, the parieto-palatine being a differentiated portion of the tensor. The change in these muscles has been brought about by the position taken by the pterygoid bone, it having encroached on the region where normally the tensor and levator palati have an insertion into fibrous membrane only. Regarding the nerve supply, which is somewhat difficult to make out, the parieto-pterygoid is supplied by a nerve that issues from an aperture in the alisphenoid, and occupies such a position relative to the fifth as a nerve coming from the otic ganglion would.

The spheno-pterygoid appears to be supplied from the seventh.

Sub-occipital Articular.

Sub-occipital articular, Dugès, Duvernoy, Owen, and R. Jones; not mentioned by D'Alton or Hoffmann.

The muscle springs from the posterior portion of the basi-sphenoid and the anterior part of the basioccipital. It passes outwards and backwards to be inserted on the middle third of the posterior border of the quadrate. As the muscle runs outwards it lies as a thin sheet on the posterior portion of the spheno-pterygoid muscle; while the dorsal muscles lie internal to it.

The two sub-occipital articular muscles are described as constituting an azygos muscle. There are, however, two distinct muscles, each arising as stated above. Again, the muscle is not so closely related to the quadrato-mandibular joint as the name would seem to imply.

A similar muscle is described by Sanders (25) in *Platydactylus japonicus*, and in *Liolepis belli*, whilst we have found it to be present in *Hydrosaurus*. Sanders considered it to represent the laxator tympani, while Owen compares it to the depressor tympani of fishes. We, however, think that, if the muscle is tympanic in nature, it will represent the tensor tympani.

The Dorsal Muscles.

The dorsal muscles may be divided into two groups, the mesio-dorsal and the latero-dorsal. The first consists of the spinalis and longissimus sets, the second of the sacro-lumbalis and accessorius.

Mesio-dorsal group (Humphry), *Neuro-mesial* (Owen).

The superficial fascia that covers the dorsal muscles is scanty. It is connected above with the neural spines, and from thence runs outwards over the spinalis, longissimus, and sacro-lumbalis, where it blends with the superficial layer of the external oblique.

The fascia is the representative of the external oblique stratum continued over the dorsal muscle. This is well shown in the anterior fourth of the body of *Daboia*, where the muscular fibres of the oblique layer completely replace the fascia. In the other forms examined it was only on approaching the head that the muscular fibres became conspicuous.

M. SPINALIS DORSI.

M. capito-vertebralis, Hoffmann; *Der aufsteigende Muskel zwischer den Dorn- und Gelenkfortsätzen*, D'Alton; *M. spinalis*, Hübner, Owen, Jones; *Dorn- und Halbdornmuskel*, Meckel.

The spinalis dorsi arises from the upper portion of the lateral surface of the neural spine, and from an aponeurosis which stretches between the neural spines and the zygapophysis, covering in the multifidus. Each part of the muscle runs forward as a rounded belly, ending in a long slender tendon which is inserted into the apex of the neural spine of the ninth vertebra from the origin. The tendons of the muscles are arranged so that the anterior ones lie external to, and beneath, the posterior; at the same time the tendons are connected with one another by fascia so that an aponeurosis is formed. The fascia is also modified to form a number of thecal sheaths, thus enabling the tendons to move with great facility. Tendons from the longissimus join this aponeurosis.

The muscle presents no points of difference in any of the forms examined, and the above description might apply even to the spinalis of *Hydrosaurus*. The muscle is supplied by the internal branches of the posterior primary divisions of the spinal nerves.

M. SEMISPINALIS DORSI.

The tendons of the semispinalis arise from the flattened surface on the upper side of the postzygapophysis. Running upwards, forwards and inwards, the tendons end in well marked bundles of muscle, which fuse with the under and lateral portions of the spinalis, and so are indirectly inserted into the neural spines. The tendons of origin are closely connected with the aponeurosis covering in the multifidus beneath.

In *Morelia* in addition to the muscular bundles that are developed at the extremities of the tendons, there are a number of leaves of muscle which spring from the anterior border of the tendons, and also from the vertical aponeurosis of the longissimus. These bundles give rise to what appears to be a distinct series of muscles running between the semispinalis and the longissimus. This series is called by D'Alton, *Zweiter oder kurzer absteigender Muskel zwischen den Gelenken und Dornfortsätzen*; by Hübner, *M. spinoso-vertebralis;* by Meckel, *Vieltheiliger Rückgratsmuskel;* by Hoffmann, *postzygapophyses-spinales.* In *Hydrosaurus* there is an intermediate arrangement between what we see in *Acanthophis* and *Morelia*, the second series becoming united with the first. We therefore consider that the bundles in *Morelia* are but specialised portions of the semispinalis proper. The internal divisions of the nerves run up and pierce the multifidus, and then lie between it and the semispinalis, supplying the latter and the spinalis, at the same time giving branches to the accessory bundles in *Morelia*.

M. MULTIFIDUS SPINÆ.

Mm. neuro-spinales, Hoffmann; *Muskel zwischen der Wirbelbogen und den Dornfortsätzen*, D'Alton.

The multifidus arises from the lower part of the lateral surface of the neural spines, immediately beneath the origins of the spinalis. It also arises from the general fascia that stretches between the neural spines and zygapophyses, separating it from the spinalis and semispinalis above. The muscle runs forwards and outwards, the superficial fibres of each bundle pass over the vertebræ to be inserted into the lamina of the fourth, the deeper fibres being attached to the laminæ of the vertebræ passed over. The tendons of origin of the spinalis run upwards and inwards over the muscles, and are closely connected with the aponeurosis stretching between the neural spines and the zygapophyses. Each moiety of the multifidus is triangular in outline, the apex being at the spine, the base at the lamina. As the tendons of the spinalis run inwards they cross the side of the triangle nearest to them; we thus have a number of acute angular spaces formed whose floor is composed of the aponeurosis mentioned above. It is from these spaces that the spinalis dorsi arises in part.

If we consider this muscle as multifidus, we are met by the difficulty that the fibres run from the mid-line outwards. But the direction of the fibres being the result of function, and therefore necessarily inconstant in direction, we do not consider that this is a sufficient reason for not regarding the muscle as multifidus.

The relation of the nerve, running between the muscles and the semispinalis, adds to the idea of its homology with the multifidus.

In *Hydrosaurus* the muscle takes the same direction, but each bundle of fibres is in this case arranged around a strong tendon in a pinnate manner, the tendon running from the neural spine outwards to the laminæ and zygapophyses.

As we have shown, the multifidus is attached to the laminæ over which it passes, and some of the lowermost fibres consequently pass from one lamina to another only. We, therefore, get a series of small muscles which represent the rotatores dorsi. Those are described by D'Alton as "die obere Reihe zwischen den Gelenkfortsätzen;" and by Hoffmann as part of the intertransversarii. The nerve fibres pierce these muscles.

Mm. interspinales.

Mm. interspinales, Hoffmann, Owen; *Zwischendornmuskeln*, Hübner, Meckel, D'Alton.

The interspinales arise from the anterior border of the neural spine, and run forwards and slightly outwards to be inserted on each side of the posterior borders of the spine immediately in front, and slightly into the laminæ leading up to the spine.

Hoffmann has described this muscle; but in the figures attached to his paper he has described as interspinales the postzygapophyses spinales.

M. LONGISSIMUS DORSI.

M. semispinalis, Hoffmann ; *Der lange, absteigende Muskel zwischen den Gelenk- und Dornfortsätzen*, D'Alton ; *Halbdornmuskel*, Meckel ; *Longissimus dorsi*, Owen, Jones.

The longissimus dorsi arises by tendons from the processes of the anterior zygapophyses. The tendons of origin are blended together, so that a vertical aponeurosis is formed which stretches between the zygapophyses, separating the longissimus from the spinalis group, and at the same time helping to give origin to the semispinalis. As the tendons run upwards and forwards they pass into muscular bundles, which are arranged in a laminated position, the posterior overlapping the anterior.

Thus a column of muscle is formed which gives off two sets of tendons, an inner and an outer. The inner set runs towards the neural spines, and joins the tendons of the spinalis, helping by this means to form the median aponeurosis described above. The outer set serves to give origin to the sacro-lumbalis muscle, and as in the case of tendons of origin an aponeurosis was formed, so now these outer tendons are joined together, and a partition is by this means formed between the longissimus and the sacro-lumbalis. This aponeurosis reaches down to the ribs where it is attached, and so the muscle gets an insertion by this means.

The muscle by its inner tendons acts as a semispinalis ; while its outer tendons can act as retractors of the ribs.

We are at a loss to understand on what ground Hoffmann and Meckel could consider this muscle as a semispinalis.

The muscle is supplied by the external division of the spinal nerves.

M. INTER-TRANSVERSARII.

M. inter-transversarii, Hoffmann (lower part); *Die untere Reihe der Gelenkfortsätzen*, D'Alton.

Belonging to the longissimus series is a small muscle which runs between the processes of the anterior zygapophysis. Some of the fibres as they pass backwards spread out over the fascia covering the levatores costarum.

These muscles correspond to the lower pair of intertransverse muscles described by D'Alton and Hoffmann; their superior inter-transverse muscles we consider to be really part of the rotatores dorsi group. They are separated from the latter muscles by the aponeurosis of the longissimus tendons at their origin, and by the internal divisions of the nerve trunks, while they are separated from the levatores costarum beneath by the external divisions of the posterior portion of the spinal nerves.

Latero-dorsal group. (Humphry).

M. SACRO-LUMBALIS.

M. retractor costæ biceps, der zweibauchige Ruckwartszieher der Rippen, D'Alton; *Stratum secundum et tertium*, Hübner; *M. opistothenar*, Meckel; *sacro-lumbalis*, Owen, R. Jones.

The sacro-lumbalis is a muscle composed of two columns, an internal and an external.

The muscular bundles of the internal column arise from the aponeurosis formed by the external tendons of the longissimus muscle; they also have an origin from the tendons of insertion of the accessorius. Each bundle is somewhat flattened and runs upwards and forwards to form a column of muscles, whose external surface splits into a number of leaves which constitute the external column. The elements of this external column are inserted by means of tendons, which run downwards and forwards to the ribs at the point where the levatores costarum arise, the tendons of the two being closely connected.

In dissecting a dog at the time of writing this paper, we were struck by the similarity of the constitution of the sacro-lumbalis and accessorius in that animal with these muscles in the snake, the position of the nerves being also similar.

The external portions of the posterior primary division of the spinal nerves run up internal to the external aponeurosis of the longissimus, and giving off a branch to supply this muscle and the inter-transversarii, pierce the aponeurosis and supply the sacro-lumbalis and accessorius.

M. ACCESSORIUS AD SACRO-LUMBALEM.

Mm. praezygapophyses - costales, Hoffmann; *Gelenkfortsat-rippenmuskeln oder lange Rippenheber*, D'Alton; *Stratum quartum*, Hübner.

The accessorius is made up of a number of small muscles, each of which springs from the junction of the inner with the outer third of the ribs, and runs forwards and inwards to be inserted into the head of the third rib from the origin. These muscles are hidden from view by the sacro-lumbalis which lies above. They are not attached to the zygapophyses, as stated by Hoffmann and D'Alton.

Cranio-vertebral muscles.

M. SPINALIS CAPITIS.

M. capito-vertebralis, Hoffmann; *Der aufsteigende Muskel zwischen den Dorn- und Gelenkfortsätzen*, D'Alton; *M. spinalis*, Hübner; *Dorn- und Halbdornmuskel*, Meckel.

The spinalis dorsi is continued forward towards the head, where it is inserted on the supra- and exoccipital bones close to the middle line. The only change that is noticeable is that the muscle becomes more fleshy, the tendons of insertion into the spinous process being much smaller. Its insertion in the skull is tendinous. The continuation of the spinalis in *Diemenia* is not so well marked as in the other forms. If we follow the muscle forward we find at about the tenth dorsal vertebra, that the bundles begin to end in rounded bellies, which are continued on by long tendons to the neural spines; the most anterior being inserted on the spine of the axis, while a few muscular fibres reaching from the axis to the skull, show that there is a continuation on of the muscle. With this arrangement in *Diemenia* we have a greater development of the complexus than in other forms. The continuation of the muscle on to the skull is no doubt accounted for by the function that it performs, it being able to draw the head well back. This is of especial value in venomous snakes, for it is by this means that the fangs are disengaged from the prey.

The continuation of the spinalis is met with to some degree in man in the spinalis cervicis muscle; and we may, perhaps, regard the fasciculi going to the complexus as part of this continuation.

Rectus capitis posticus major et minor, et obliquus capitis inferior.

If we follow the multifidus forward we find that the bundles springing from the anterior three vertebræ are conspicuous for their size. The most anterior bundle springs by a tendon from the spine of the axis and partly from the atlas, and running as a well-defined rounded muscle is inserted on the exoccipital. This we consider to represent the rectus minor. The next bundle springing from the third vertebra is well defined, running to be inserted on the exoccipital close to the minor. This we take to be the representative of the rectus major.

The obliquus is not defined as a separate muscle, but it is plain that as the muscle bundles of the multifidus run forward and outward, that a muscle will run from the anterior spines to the lateral portion of the atlas, and so represent the obliquus inferior.

M. complexus.

At about the tenth vertebra from the head, there are developed between the spinalis and longissimus a number of muscular bundles, which take the place of the meagrely developed semi-spinalis. The bundles arise from all the anterior vertebræ except the atlas, and coalesce to form a well-defined muscle which is inserted on the exoccipital close to the insertion of the spinalis. In *Diemenia* the muscle is very conspicuous, and is developed in proportion to the slight insertion of the spinalis on the skull.

We consider that this muscle represents the complexus, although it is on the same plane as the semispinalis.

M. TRACHELO-MASTOIDEUS.

This muscle is formed by the continuation of the bundles of the longissimus on to the skull. The muscle is a well-defined band inserted on the exoccipital immediately beneath the squamosal bone, being partly hidden from view by the complexus.

M. CERVICALIS ASCENDENS.

This muscle represents the continuation of the accessorius and sacro-lumbalis on to the skull. As these muscles run toward the head the bundles coalesce and form a single column of muscle, which is inserted on the lower tubercle of the exocciptal, being covered by the tendon of the superior rectus anticus at its insertion.

The muscle, like the spinalis, is produced on to the head to serve a special function, since by its action it helps the snake to "strike," and afterwards helps to disengage the fangs by pulling the head first to one side and then to the other.

The Internal oblique stratum.

The internal oblique stratum comprises the greatest part of the muscles that go to make up the bulk of the snake's body. If we reflect the anterior prolongation of the sacro-lumbalis column, we come on a sheet of muscle springing from the diapophyses of the anterior vertebræ, which are without ribs. The bundles composing the sheet run backwards and outwards till they meet the first rib, whereon some of the fibres are inserted, while others are prolonged over the external surface to be inserted on the second rib. This sheet represents the scalene group. If we follow the stratum as it runs back towards the posterior extremity, we see that true external intercostals are formed between the ribs. Of these external intercostals those fibres which are nearest the vertebræ begin first to alter their direction, so that we have formed a series of levatores costarum externi, whose fibres are directed from within, backwards, and outwards; and since the layer reaches through the whole depth of the intercostal space, we have the internal fibres similarly affected, and thus are produced the levatores costarum interni. But not only do the fibres next the vertebræ change, but also those which lie between the intercostal cartilages change from the true external intercostal direction to a more antero-posterior one. This is brought about by the cartilages of the ribs bending forward. Thus are produced the "retrahentes costarum breves" (Hoffmann). We find the arrangement described above on the first intercostal spaces; but as we go more posteriorly we find, arising from the ribs at the place where the levatores costarum interni are inserted, bundles of fibres which run outwards and backwards over two or three ribs. These are the first pretrahentes costarum superiores; and they are evidently formed by the continuation of the fibres of the external intercostals over more than one intercostal space. It is to be noted as supporting this, that they spring from where the levatores are inserted, and that where there are levatores there are no other muscles of this group overlying them. As we follow these muscles back, we find that the fibres cross more intercostal spaces until they reach their maximum by being inserted into the ninth rib from the origin, at the same time however they give slips to all the ribs crossed over. Not only have we formed a group of pretrahentes costarum superiores, but we have also an inferior group formed in the same manner, the only difference between the two being that the fibres of the inferior group, since they arise at the junction of the inner two-thirds with the outer third, must necessarily run more antero-posteriorly than the superior group.

Beside these intercostal muscles we have obliquus internus proper, and also a rectus, with its modification in the scutal muscles and the hyoid group.

Pretrahentes costarum superiores.

Mm. pretrahentes costarum, Owen; *Intercostales superiores*, Hoffmann; *Obere, lange Zwischenrippenmuskeln*, D'Alton; *Stratum quintum*, Hübner; *Vorderer, gezahnter Muskel*, Meckel; *Great lateral costal muscles*, R. Jones.

The pretrahentes superiores arise from the junction of the inner with the middle third of the superior border of the rib, close to the point of insertion of the levatores costarum group. Each muscle runs outwards, backwards, and downwards, to be inserted into the ninth rib from the origin at the junction of the middle with the outer third. Each muscle as it passes back gives slips of insertion to all the ribs that it passes over. The muscle arises by long thin tendons which are closely connected with the tendons of insertion of the sacro-lumbalis.

Each bundle of an anterior portion of the muscle is external to a posterior bundle. The muscles, taken as a mass, form well-marked prominences on the sides of the snake, and help in a greater measure to determine the bulk of the snake. Home and R. Jones describe each bundle of these muscles as running over four ribs only; this, however, is not correct. As stated above, we believe these muscles to be modified external intercostals. The large lateral branch of the intercostal nerve that leaves the anterior of the body, is chiefly distributed to this muscle, and the next to be described.

Pretrahentes costarum inferiores.

Mm. intercostales inferiores, Hoffmann; *Untere lange Zwischenrippenmuskeln*, D'Alton; *Stratum sextum*, Hübner; *Aeusserer schiefer Bauchmuskel*, Meckel; *Extension of the pretrahentes superiores*, Owen; *Great inferior costals*, R. Jones.

The pretrahentes inferiores arise from the ribs at the point where the superiores are inserted, and running back nearly parallel with the long axis of the body, they are inserted on the ninth rib from the origin. As they run back they likewise give slips to the ribs over which they pass. The muscles are sometimes described as being continuous with the upper set; they are distinguished from the upper set by the bundles running more antero-posteriorly. They, however, appear like the superior muscles to be modified intercostals.

Mm. levatores costarum externi.

Mm. levatores costarum, Hoffmann; *Rippenheber*, D'Alton, Hübner, Meckel; *Transverso-costal*, R. Jones; *Levatores breviores*, Owen.

The levatores costarum arise from the process extending upwards from the diapophysis, also from the rib articulating with the diapophysis. Each muscle runs backwards, and slightly downwards, to be inserted on the upper portion of the inner third of the anterior surface of the rib immediately behind. The muscle can act not only as an elevator to the ribs, but also as an external oblique muscle. The levatores costarum are wholly hidden by the sacro-lumbalis and accessorius; these, however, being separated from them by the origins of the external oblique from the lateral septum.

Each muscle is supplied by a branch from the intercostal nerves; it emerges close to the line of insertions.

Mm. levatores costarum interni.

Mm. costo-vertebrales inferiores, Hoffmann; *Innere, kleine vorwärtszieher der Rippen*, D'Alton; *Innere Rippenheber*, Meckel; *Spinoso-costales*, Hübner.

The levatores costarum interni arise from the base of the hypapophyses and from the inferior surface of the centrum. They run outwards, and backwards, to be inserted into the under surface of the head of the rib, immediately behind.

This is the arrangement in all the venomous snakes that we have examined; but in *Morelia* and other non-venomous forms the levatores costarum are large muscles arising from the hypapophyses and inserted into the third vertebra behind. The intercostal nerve runs internal to these muscles, separating them from the transverse layer.

In *Morelia* the levatores form the prominent muscular column on the inferior surface of the vertebral column when the depressores have been reflected, while the subvertebral rectus is but slightly developed. In *Acanthophis* and in all venomous forms that we have examined, the subvertebral rectus forms the prominent column, the levatores being insignificant. This peculiarity has not been before pointed out.

Mm. intercostales externi.

Mm. intercostales proprii, Hoffmann ; *Zwischenrippenmuskeln*, D'Alton and Meckel ; *Intercostal*, R. Jones, Owen.

The external intercostals spring from the posterior and inferior surface of one rib, and are inserted on the anterior surface of the rib immediately behind. The muscle extends from the head of the rib to the extremity, where the costal cartilages arise. The muscular fibres run from before backwards and outwards, taking the usual direction of external intercostal fibres. Between the intercostal cartilages the fibres run more antero-posteriorly, and so this portion of the muscle is usually described as though it were a distinct muscle.

On comparing this portion of the muscle to the corresponding portion in *Hydrosaurus*, we find that the same alterating in the direction of the fibres has occurred but to a less degree, and the muscle is so obviously but a continuation of the external intercostals, that we do not see the necessity for a distinct name.

Hoffmann has named these antero-posterior fibres *Mm. retrahentes costarum breves ;* D'Alton, *Muskeln zwischen Rippenknorpeln;* Hübner, *Intercostales recto-decursu binas costas intercedentes ;* Meckel, *Gerader Bauchmuskel ;* Owen, *Rectus abdominis.*

The intercostals are covered superiorly by the levatores costarum, and the pretrahentes superiores and inferiores. Inferiorly they are separated from the depressores costarum by the intercostal nerves. The main portion of the latter pierces the muscle, so as to gain the superior surface, at a point where the depressores are inserted into the ribs, and on arriving at the surface supplies the pretrahentes group.

M. obliquus internus.

M. cutaneus internus, Hoffmann; *Der innere oder untere Bauchhautmuskel*, D'Alton; *Innerer, schiefer Bauchmuskel*, Heusinger.

The internal oblique is composed of a number of "leaves" of muscle, which arise from the external surface of the costal cartilages; and in addition a tendinous expansion spreads over the pretrahentes costarum inferiores, constituting a lateral portion of the muscle. The whole runs forward and inwards towards the mid-line, the "leaves" of muscle widen by encroaching on the lateral tendinous portion, and then fuse with the upper layer of the rectus, which is differentiated to form the scutal muscles; at the same time these "leaves" give rise to a tendinous expansion internally, which fuses with the fascia of the transversalis in the mid-line.

We do not find that an obliquus internus is described in the snake by other writers; the muscle "leaves" mentioned above correspond, we believe, with portion of the rectus as described by Humphry in *Pseudopus.* We however think, after comparing this muscle with the internal oblique of *Hydrosaurus*, that we have given its true homology.

If we follow the internal oblique forward we find it converted into the costo-mandibularis, or, as pointed out in the description of that muscle, into a muscle which represents the sterno-hyoid group.

M. rectus.

Hautmuskeln, Hoffmann, D'Alton.

The rectus is represented by a large mass of muscle, which is chiefly concerned in forming the scutal bundles. It consists of two layers. The inferior is composed of a broad sheet of muscle whose fibres run antero-posteriorly. This layer is inserted on to the upper surface of the ventral scutes, and is continuous laterally with the external oblique muscle. The superior layer is differentiated into special bundles, which constitute the scutal muscles proper. The several bundles occupy different planes, and have different degrees of obliquity as regards the mid-line. Thus there is a median bundle occupying the mid-line whose fibres run antero-posteriorly. This is the M. interscutalis proprius of Hoffmann. On the other side of this are bundles whose fibres run from without inwards and forwards. These are the Mm. scutales mediales. Between these sets of muscles, and occupying a higher level, we have bundles running from within outwards and forwards. These are the Mm. pyramidales. Running from the mid-line outwards across the latter muscles, and consequently occupying a higher place, we find bundles called Mm. interscutales majores. It is with these latter bundles that the fibres of the internal oblique muscle fuse.

If we follow the rectus forward we have the deeper layer still attached to the ventral scutes, while the superior layer is converted into the hyoid group of muscles, with the exception of the mylohyoid; and we thus get portion of that stratum named by Humphry the "deep brachio-cephalic."

M. OBLIQUUS EXTERNUS.

M. cutaneus externus, Hoffmann; *Der grosse, äussere oder Seitenhautmuskel*, D'Alton; *Aeusserer, schiefer Bauchmuskel*, Heusinger.

The external oblique muscle consists of two layers. The superficial of these is continuous with the fascia covering the dorsal muscles. As we shall see later on this fascia is gradually replaced by the superficial layer as we go towards the anterior extremity of the snake. The deep layer is made up of a number of bundles which spring from the fascia representing the lateral septum, lying between the sacro-lumbalis and the levatores costarum muscles. The bundles run outwards and backwards over the pretrahentes costarum superiores, and coalescing with the superficial layer, the whole muscle is inserted on the lateral scutes, its fibres gradually fusing with the lateral portion of the rectus.

If we follow the external oblique layer forward, we find that the superficial layer which we saw represented but slightly in the posterior part of the body, now becomes conspicuous, since the muscular bundles replace the fascia that overlay the dorsal muscles. This layer is attached to the aponeurosis formed by the tendons of the spinalis dorsi, and it is also prolonged over the head muscles and beneath the mandible. The most anterior of the fasciculi of the deep layer are attached to the quadrate. We thus have formed what is called by Humphry a "superficial brachio-cephalic stratum," which is divided again into a cervicalis superficialis superior and inferior.

The cervicalis superficialis superior has in turn a superficial portion, constituted by a platysma, and a retractor oris, depressor mandibulæ, and retractor quadrati.

The cervicalis superficialis inferior is represented by an intermandibularis anteriorly, and a mylohyoid posteriorly. The deep layer of the external oblique that we saw attached to the quadrate, represents the sterno-mastoid; while the whole of the cervicalis superficialis superior represents the sphincter colli of birds.

Platysma.

M. atlanto-epistropheo-hyoideus, Hoffmann; *Rückwärtszieher des Zungenbeins*, D'Alton.

The platysma is represented by a slight layer of muscular fibres extending upwards over the retractor oris, and running forward to be lost on the masseter.

The platysma is not mentioned as occurring in Ophidians; but the following facts tend to show that we are justified in considering that a platysma is really present.

In *Python bivittatus*, D'Alton found a band of muscular fibres extending from the neural spines round to the hyoid bone. We have found the same in *Morelia* and in *Hydrosaurus*; in the latter this band being but a superficial part of the well-developed platysma.

We see, therefore, the disappearance of a sheet of muscle as a whole from a class of animals in which it could obviously be of no use, but at the same time a specialised band of muscle remains, since it performs a function quite foreign to that of the platysma.

In *Acanthophis* and the other venomous snakes examined, the band was not so well developed as in *Morelia.*

Retractor oris.

Retractor oris, Humphry; *Cervico-angular,* Duvernoy; *M. cervico-mandibularis (sphincter colli),* Hoffmann; *Trachelo-mastoideus,* Owen; *Nackenunterkiefermuskel,* D'Alton; *M. temporalis,* von Teutleben; *M. cervico-mandibularis,* Cuvier.

The retractor oris arises from the aponeurosis of the spinalis attached to the anterior three or four neural spines. Running forward, outwards, and downwards, over the digastric and posterior portion of the articular, the muscle ends in a tendinous expansion inserted into the symphysis of the lips and the integument adjoining.

In *Daboia* and *Morelia* this muscle divides into two layers as it runs forward, the deeper one being inserted into the articular, the superficial having the same arrangement as in *Acanthophis.*

The muscle may represent a zygomaticus major. It certainly corresponds to the retractor portion of the cervicalis superficialis of *Lepidosiren* and the dogfish, as pointed out by Humphry. On the other hand, it corresponds to part of the sphincter colli of birds.

The muscle acts as a tensor of the symphysis of the lips, thus enabling the inferior portion of the masseter to work with a "pully-like" action round the symphysis. Some of its fibres also pass on to the capsule of the venom gland, thus serving to steady the gland when the masseter is contracting on it.

M. retractor ossi quadrati.

M. retractor ossi quadrati, Hoffmann; *Rückwärtszieher des quadratum,* D'Alton; *Filum musculare s.-tendinosum* (?), Hübner.

This small band of muscle springs by a very delicate tendon from the posterior portion of the upper extremity of the quadrate. Running backwards and downwards the tendon gives way to a muscle which passes beneath the retractor oris but lies on the depressor mandibulæ. When the muscle reaches the costo-mandibularis, its fibres spread out and are lost over this latter muscle.

The muscle represents a portion of the sphincter colli of birds.

Depressor mandibulæ.

M. depressor mandibulæ, Humphry; *Neuromandibularis*, Duvernoy, Owen, R. Jones; *M. cervico-hyoideus* (in part), Hoffmann; and *Nackenzungenbeinmuskel*, D'Alton.

The depressor mandibulæ arises from the aponeurosis attached to the neural spines of the sixth to the twelfth vertebræ. The muscle runs forward as a broad sheet over the pretrahentes costarum superiores, and the deep bundles of the external oblique, then bending beneath the end of the mandible it is joined by the costo-mandibularis, and thereupon becomes mylohyoid.

In *Daboia* and *Pseudechis* the muscle is intersected by two tendinous bands running from the hyoid bone outwards towards the end of the mandible. In these cases the muscle is quite separated from the mylohyoid.

Humphry describes in *Pseudopus* one band occupying the position of the posterior one here, and he remarks that Reudinger supposes it to represent an acromion. From what we have said above we regard these bands as part of the cornua of the hyoid.

The muscle is separated from the retractor oris, by a slight interval, as it approaches the quadrate. This is explained on referring to *Hydrosaurus* where we see the external auditory apparatus occupying the interval.

This muscle also corresponds to part of the sphincter colli of birds.

M. mylo-hyoideus.

M. mylohyoideus, Hoffmann; *Kieferzungenbeinmuskel*, D'Alton; *Latissimus ingluviei, s. platysma myoides*, Hübner; *Hautthalsmuskel*, Meckel; *Costo-mandibularis*, Owen.

The mylohyoid, as mentioned above, is formed by the coalescing of the fibres of the depressores mandibulæ and costo-mandibulæ. The muscle may be said to arise from the ossified part of the hyoid, and from the tendinous intersections when they are present. Running forward the muscle meets its fellow of the opposite side in the median line, while laterally it is inserted on the inferior surface of the mandible, between the temporal muscle above and the pterygoid below, reaching as far forward as the dentary. The muscle forms a floor which hides from view the superior muscles together with the nerves and vessels.

From its origin at the hyoid bone the muscle is able to protract the lingual sheath and so act on the tongue, thus resembling a genio-hyoid function.

M. INTERMANDIBULARIS.

M. intermandibularis, Owen, Duvernoy; *Die sich kreuzen den Muskeln des Unterkiefers*, D'Alton; *Cervico-hyoideus* (in part), Hoffmann.

This muscle springs from the lower border of the anterior two-thirds of the dentary. The fibres run inwards and backwards to the mid-line, where they meet the fibres of the opposite side. At their junction a well marked median raphe is formed. These muscles are evidently but portions of the mylohyoid, whose fibres have changed their direction with their corresponding change in function, *i.e.*, to bring the divaricated mandibles together. In *Hydrosaurus*, where the muscles could be of no use in this respect, the fibres of this region are specially modified to serve as compressors of the sublingual glands. In *Acanthophis* a small band is detached from the upper surface which winds round each sublingual gland and performs this function. This band was first pointed out by Leydig.

From the posterior portion of the muscle a well marked band of fibres runs back. It lies above the mylohyoid, and is inserted into the inferior surface of the mandible. In *Daboia* it is connected with the anterior fibrous intersection. It may represent a cerato-mandibular as seen among lizards.

M. COSTO-MANDIBULARIS.

M. costo-mandibularis, Duvernoy, Jones and Owen*; included in the Cervico-hyoideus* of Hoffmann and D'Alton.

The costo-mandibularis is formed by plates of muscle which spring from the costal cartilages of the third to the tenth rib. These bundles correspond to those described as forming posteriorly the internal oblique proper. Instead of being inserted into the superior layer of the rectus, the bundles are collected into a sheet which runs forward above the fibres of the depressor mandibulæ, and coalesces with them, helping to form the mylohyoid, at the same time becoming inserted into the hyoid bone.

In *Daboia*, however, where the tendinous intersections occur, these bundles are inserted into the posterior tendinous band, and thus represent a sternohyoid muscle.

Hoffmann has followed D'Alton in describing this muscle as part of the depressor mandibulæ, but from its formation and relations, it clearly belongs to the middle and not to the external stratum.

From its insertion into the hyoid the muscle can act as a retractor of the lingual sheath and tongue, thus resembling the action of the sternohyoid.

By its continuation into the mylohyoid, and so indirectly on to the mandible, it can act as a depressor of the lower jaw.

M. HYO-GLOSSUS.

M. hyoglossus, Hoffmann, Owen; *Zungenbeinmuskel*, D'Alton.

The hyoglossi come into view when the mylohyoid is reflected. The muscles arise as two rounded bellies from the inner side of the ossified hyoid rods. Running forward the muscles coalesce, and are continued as one muscle into the lingual sheath, where they join the intrinsic muscles of the tongue.

These muscles are generally taken to represent the hyoglossi, but it is doubtful if this is their true homology. Owen is certainly wrong when he describes the whole tongue as composed of hyoglossi. In *Pseudechis* the muscles arise from the anterior third of the hyoid bones, while at the posterior third there is an interhyoid muscle; the hyoid bones in this species being remarkable for their length. The muscles are similar in *Hydrosaurus* to those described above.

M. GENIO-HYO-GLOSSUS.

M. maxillo-hyoideus, Hoffmann; *Genio-hyoideus*, Meckel; *Vorwärtszieher des Zungenbeins*, D'Alton; *Genio-hyo-glossus*, Owen; *Genio-vagiens*, Duvernoy.

This muscle arises by two heads—the external from the junction of the anterior with the middle third of the dentary, the internal from the median raphe of the intermandibularis. The two heads running backwards and inwards coalesce, and are inserted on the lingual sheath, and on the anterior portion of the hypobranchial rods.

These muscles are the main protruders of the tongue. The corresponding muscles in *Hydrosaurus* resemble these very closely.

M. GENIO-TRACHEALIS.

M. genio-trachealis, Owen, Duvernoy; *Maxillo-laryngeus*, Hoffmann; *Vorwärtszieher des Kehlkopfes*, D'Alton.

The genio-trachealis is a small band of muscles arising from the same spot as the outer head of the genio-glossus. It runs backwards and inwards to be inserted on the side of the trachea; at the same time some fibres spread out on the lingual sheath and the floor of the mouth.

This muscle appears to represent a dismemberment of the genio-glossus. The muscle is present in *Hydrosaurus*. The action of the muscle is to protrude the trachea while the animal is passing a large prey through its gape.

M. HYO-TRACHEALIS.

M. hyoideo-laryngeus, Hoffmann; *Rückwärtszieher des Kehlkopfes*, D'Alton; *Retrahens laryngis*, Hübner.

The muscle arises from the anterior portion of the hyoid rod, and runs forward to be inserted into the floor of the mouth close to the insertion of the genio-trachealis, while many of its fibres are attached to the trachea.

This muscle is probably a dismemberment, like the genio-trachealis, of the genio-glossus.

The Transversalis Stratum.

The transversalis stratum of the ventral muscle is well developed in snakes. If we lay open the abdomen, and turn aside the intestines, we see a well marked column of muscle lying on either side of the hæmal spines, whose fibres run forward and outwards; the columns are composed of the depressores costarum. On removing these muscles, we come on a levator layer, running from before backwards; these represent a subvertebral rectus. On either side of the depressores, we have the transversalis muscle and fascia lying in a sheet beneath the ribs, and hiding from view the retrahentes costarum running from before, backwards, and outwards. We do not find any internal intercostals, their place being taken by the depressores and retrahentes, which we regard as greatly altered internal intercostals.

If we trace the depressores forward we find them being converted into longus colli and rectus capitis anticus.

M. TRANSVERSALIS.

M. abdominis externus et internus, Hoffmann; *Der äussere Bauchmuskel, und der innerere Bauchmuskel,* D'Alton; *M. transversalis*, Owen.

The transversalis muscle proper is represented by two sheets of muscle, which spring from the junction of the outer with the inner half of the inferior surface of the ribs, just external to the insertion of the depressores costarum. Two layers composing the transversalis run downwards and inwards, the muscular fibres gradually giving place to a strong tendon which meets its fellow of the opposite side along the middle ventral line.

In the non-venomous snakes, with the disappearance of the hypapophyses, the transversalis is continued inwards as a sheet of fascia, containing a slight amount of muscular tissue, and is inserted on the anterior common ligament, coalescing with the fascia that gives origin to the depressores costarum in this region. We see therefore that the transversalis very distinctly arises from the vertebral column in non-venomous snakes, and that in venomous snakes the very slight layer of fascia found beneath the depressors is the representative of this sheet, which corresponds to the anterior lamella of the tendon of origin of the transversalis in higher animals.

With regard to the two sheets of muscle bundles making up the main body of the muscle, the external one has its fibres arranged in bundles, the direction of the fibres being from without inwards and forwards, corresponding to the direction of the retrahentes costarum, and therefore having such a direction as a subcostal group of muscles would take. The layer corresponds with D'Alton's *äussere Bauchmuskel.* The inner layer has its bundles of fibres placed in a direction corresponding to a true transversalis muscle.

M. DEPRESSORES COSTARUM.

M. costo-vertebrales superiores, Hoffmann; *Innerer, grosser Rückwärtszieher der Rippen*, D'Alton; *Costales interni superiores*, Hübner; *Transverso-costal*, R. Jones; *Retrahentes costarum*, Owen.

The depressores costarum arise from the extremities and sides of the hypapophysis. The muscular bellies coalesce at their origin, and then run forwards and outwards, each to be inserted by a tendon on the middle of the posterior border of the fourth rib from the origin, at the same time giving slips to the ribs over which they pass. This is the arrangement in venomous snakes, but in *Morelia* a considerable change takes place with the disappearance of the hypapophysis. Instead of the muscular bundles arising directly from the vertebræ, they now arise by means of a strong aponeurosis attached to a well marked anterior common ligament, stretching between the tubercles representing the hypapophyses. Along with this mode of origin we have also a change in the appearance of the muscles, which now have the appearance of a number of quadrilateral plates, and these do not form such a prominent column as when the muscles arise from the well developed hypapophyses. The muscles are separated from the internal levatores costarum by the intercostal nerves; while below or internal to it is the vertebral fascia of the transversalis muscle. These muscles are present in all the lizards that we have examined, *Hydrosaurus*, *Calotes*, *Hinulia*, etc.

St. George Mivart describes them in *Menopoma alleghaniense*, adding the remark that "the muscle gets thinner and smaller backwards, but anteriorly it enlarges and passes in a fleshy mass beneath the skull." He also describes them in *Iguana tuberculata*, while Sanders mentions them in *Platydactylus japonicus*. Humphry describes them in *Cryptobranchus* and *Pseudopus*. The lower part of the longus colli in higher animals shows us the cervical representatives of these muscles. The arrangement of the origin of different parts of this muscle may offer some explanation as to the varying length of the hypapophyses.

Subvertebral Rectus.

The bundles of fibres which compose the subvertebral rectus spring from the sides and the bases of the hypapophyses, and running backwards and slightly outwards are inserted into the parapophyses of the third vertebra from the origin. The bundles are well marked in venomous snakes, but are but slightly developed in the non-venomous forms. The muscles are separated from the levatores costarum interni by the intercostal nerves; whilst they lie on the depressores costarum beneath.

We can find no reference to a subvertebral rectus as occurring in snakes, as it seems that this muscle has generally been taken along with the levatores costarum interni. That it belongs to a different group of muscles is evident from the relation of the intercostal nerves to it.

Mm. retrahentes costarum.

Mm. retrahentes costarum longi, Hoffmann; *Innerer, kleiner Rückwärtszieher der Rippen*, D'Alton; *Costales interni inferiores*, Hübner; *Retrahentes costarum inferiores*, Owen.

The retrahentes costarum arise from the anterior border of the ribs at the junction of the inner three-fifths with the outer two-fifths. The flat quadrilateral bundles run forward and inwards, passing over three ribs to be inserted into the fourth at the place where the sternal cartilages join the ribs, at the same time giving slips to the ribs passed over. The muscles are separated from the external intercostals by large branches of the intercostal nerves; while they are also separated from the transversalis muscle proper by branches from the intercostal nerves.

These muscles most probably represent modified internal intercostals, combined with subcostals.

M. rectus capitus anticus.

M. rectus capitis anticus major et minor, Hoffmann; *Der grosse, untere, und der kleine, gerade Kopfbeuger*, D'Alton; *Der gerade Seitenmuskel des Kopfes order Seitwärtsbeuger*, Meckel; *Rectus capitis inferior*, Hübner; *Longus colli*, Owen; *Transverso-spinalis inferior*, Jones.

The rectus anticus is formed by the forward extension of the depressores costarum. These muscles as they approach the head divide into a superior and inferior layer. The inferior layer is formed thus:—the various bundles instead of running outwards and forwards to be inserted into the ribs, run inwards and forwards, and coalesce to form a single column of muscle which is inserted into the tubercle on the basioccipital bone close to the median line.

The superior layer still continues to have its bundles inserted on the ribs, until it reaches to the fourth vertebra, when the bundles coalesce and a second column of muscle is formed similar to the first, but running outwards and forward to be inserted into the lower tubercle of the exoccipital.

The first of these columns is called by Hoffmann the "rectus anticus major," and the second one the "minor." The only objection to be offered to this is the fact of the different directions of the muscles, since they run from within outwards instead of from without inwards.

The form of these muscles is similar in all the snakes examined, and is much the same in *Hydrosaurus*. The reason for this great development is to be found in the fact that they are the main muscles by which the snake "strikes."

M. LONGUS COLLI.

The longus colli is not described in snakes, although we shall show that it is really represented.

The muscle which we have described above as the subvertebral rectus is continued forward to the skull. The first bundles spring from the basioccipital and run backwards to the hypapophysis of the atlas. This muscle might be described as a rectus medialis, but it is not met with in the higher forms, its place being occupied by the accessory ligament of the anterior occipito-atlantal. The succeeding bundles spring from the hypapophyses, and run outwards and backwards, thus resembling the longus colli; more posteriorly we have the subvertebral rectus, developed to a different degree in various forms, as we have shown above.

The Muscles of the tail, penis, and anus.

On reflecting the integument from the posterior portion of the body, we find that the columns of the spinalis and longissimus muscles are continued back to the extremity of the tail, while the sacro-lumbalis becomes much reduced, and is represented by a small band of muscle only. The bundles of the external oblique end immediately anterior to the anus, while the pretrahentes costarum superiores and inferiores run back to the last rib, where they coalesce with the bundles of the flexores caudæ. Posterior to the anus we have the flexor caudæ superficialis springing from the costo-transverse processes. The muscle meets its fellow of the opposite side in the mid-line below, and together they are prolonged forward, giving off tendons of insertion to the costo-transverse processes. Before reaching the anus they diverge, enclosing a space in which is seen the retractor cloacæ, and running forward they are inserted on the last rib, becoming continuous with the pretrahentes costarum. The layer of muscle appears to be on the same plane as the internal oblique stratum.

On reflecting this layer we come on the transversus penis and flexor caudæ profundus. The latter muscle is composed of a number of bundles springing from the costo-transverse processes; those run forward, and are inserted on the more anterior processes. The transversus penis is a well-marked sheet of muscle; the bundles arise from the hypapophyses, and run inwards and backwards, being attached to the penis, while they meet the bundle of the opposite side in the mid-line below. The nerves lie external to this layer.

On reflecting the transversus penis we find the retractor cloacæ and sphincter cloacæ, together with the penis and its retractor.

The retractores cloacæ are two columns of muscle lying on either side of the mid-line. The bundles arise from the hypapophyses, and running forward fuse with the fibres of the sphincter ani posteriorly.

External to these muscles lies a penis on either side with the retractor penis at its posterior extremity, springing from the hypapophyses.

A sphincter ani surrounds the anus, while on either side of this, external to the penis, is an elongated sphincter cloacæ. Lying above the retractor cloacæ and penis is a well marked layer of muscle, composed of bundles running from the hypapophyses backwards and outwards to the inferior costo-transverse processes. These muscles are in series with the subvertebral rectus described above.

The Spinal Nerves.

The spinal nerves emerge from the foramen formed by the notches at the bases of adjacent laminæ. They divide in the usual manner into anterior and posterior primary divisions.

The posterior primary division runs outwards for a short distance, and divides into an external and internal branch.

The external branch runs backwards and upwards, winding round the pedicle of bone supporting the prezygapophysis, between, therefore, the superior facet of the transverse process, and the tubercle of bone above. Passing under the origin of the levatores costarum externi, it ascends and pierces the fibres of the rotatores dorsi, which lie between the zygapophyses; supplying these muscles, it then comes to lie between the semispinalis and the multifidus, to each of which it gives a branch, and ultimately is lost in the spinalis dorsi.

The external branch runs upwards and outwards, and, winding round the internal side of a levator costæ externus, it comes to lie on this muscle, and beneath the longissimus to which it gives a branch. After this it pierces through the aponeurosis formed by the tendons of insertion of the longissimus, and breaking up into branches is lost in the sacro-lumbalis column.

The anterior primary division is a larger trunk than the posterior. It runs outwards between a levator costæ internus above, and the subvertebral rectus below (internal), thus separating the internal oblique stratum from the transverse. Soon it gives off two branches, one going to each levator costæ externus, the other to a levator internus.

The main branch runs outwards between the external intercostals and the depressores costarum. It gives off a well marked branch which supplies the depressores costarum, and a little more externally it supplies the transversalis muscle with a large twig which runs between the retrahentes costarum and the transversalis. When the main trunk reaches the point where the depressores are inserted it divides into two divisions. The larger of these two runs outwards between the external intercostals and the retrahentes costarum to each of which it gives branches, and then ends by supplying the pretrahentes costarum inferiores. The smaller of the two divisions, corresponding it would seem to the lateral cutaneous branches of other animals, pierces the external intercostals, and running outwards over the pretrahentes costarum superiores, and beneath the external oblique, it gives to each a branch and then continues on to reach the rectus and scutal muscles.

The Venom Gland.

When the integument is removed from the side of the head, portion of the lateral surface of the gland is displayed lying between the masseter above, and the superior labial glands below.

The superior surface is covered by the masseter; the inferior rests on the anterior part of the pterygoid muscle, the transverse bone, and the dense fascia which stretches between the pterygoid bone and the edge of the lip, and portion of the palatine aponeurosis. Internally the gland is related to the descending portion of the masseter, and is separated from the lachrymal gland and the parieto-palatine muscle by the suspensory ligament of the gland. Posteriorly it is separated from the anterior temporal muscle by another ligament.

The gland is obovate in shape, the anterior extremity being produced into the venom duct. It is surrounded by a dense fibrous capsule, which is also continued over the duct. This may be the representative of the true "parotid fascia." It is to this capsule that the masseter muscle is attached. A strong band of fascia springs from the external and posterior portion of the gland, and running back is inserted into the capsule of the quadrato-mandibular joint, and on the posterior and external ridge of the articular. This band has been named by Dugès the "zygomatic ligament," and he regards it as the representative of the zygomatic arch of birds. In the non-venomous species this band springs from the maxillary bone. It is also present in *Hydrosaurus.*

The capsule of the gland is continued into special bands of fascia, which form ligaments for its support. The best marked of these bands is the anterior, which springs from the fore part of the inner surface of the gland capsule, and is inserted on the post-orbital bone, and on the orbital portion of the lateral plate of the parietal. Immediately behind this, the fascia which lies on the internal pterygoid muscle fuses with the fascia of the capsule along portion of its inner surface. Posteriorly and internally there is a well-marked band continued down from the capsule to the symphysis of the lips; here to be connected with the foremost fibres of the retractor oris muscle.

The capsule may be stripped off the gland with a little dissection, and we then come on an internal capsule, which is intimately connected with the proper substance of the gland.

The duct of the venom gland springs from its anterior extremity, and bending forward and outward runs in a groove on the lateral face of the maxillary bone until it reaches its anterior margin, around which it bends to end in a papilla, which is in relation to the small lacuna in the groove upon the anterior surface of the fang. There is no sigmoid curve in the duct, as there is in many vipers. The minute structure of the venom gland has been examined by Emery (No. 6), and presents nothing remarkable.

Mitchell (No. 18) has described an enlargement in the duct of the venom gland of *Crotalus*, which he considers to be a sphincter muscle. He says, "the elements [of the enlargement] are undoubtedly the characteristic cells of non-striated muscular tissue. Their presence together with the form and position of the enlargement restraining the wasteful flow of the secretion."

There is no enlargement in the duct of *Acanthophis*, or any of the other forms examined, but we are not prepared to say whether any muscular fibres are present. We should think that such an arrangement would be likely to occur in all venomous snakes.

The Lachrymal Gland.

The lachrymal gland is a small oval body lying on the posterior and on the internal surface of the orbit. It is hidden from view by the anterior suspensory ligament of the venom gland; while it is related by its inferior surface to the parieto-palatine muscle. The gland does not project backwards out of the orbital fossa as in the non-venomous forms; nor does the masseter muscle give any fibres to act as a compressor, as we find in the non-venomous forms.

The Labial Glands.

The superior labial gland is represented by a number of follicles placed along the superior labium. It meets its fellow of the opposite side anteriorly, while it is continuous at the symphysis of the lips with the inferior labial gland. This runs along the edge of the inferior labium, and anteriorly meets its fellow of the opposite side.

Sublingual Glands.

The anterior sublingual glands are two in number. They are placed above the genio-hyo-glossus, and the inter-mandibularis, and are immediately in front of the opening for the tongue on the anterior portion of the floor of the mouth, into which they open by numerous ducts. Posteriorly a muscular band embraces the gland. This is derived from the inter-mandibularis, and is called the "Vorwartszieher" of the gland by Leydig (No. 16). A band of muscle proceeding from the posterior extremity corresponds to his "Rückwärtszieher." In *Hydrosaurus* the whole of the inter-mandibularis is utilized in forming a compressor for the large sublingual glands. A well marked posterior sublingual is present immediately behind the anterior ones.

In comparing the relative state of development of the glands in *Acanthophis* with the development in *Morelia* and other forms, we have come to the same conclusions as Duvernoy (No. 5).

He was the first to point out that, in the Aglyphodontians we have the superior and inferior labial glands, as well as the lachrymal gland, very extensively developed. That in the Opisthoglyphians we have the glands relatively smaller, and a venom gland begins to be developed. In the Proteroglyhphians we have the lachrymal gland quite small, while the labial glands have also decreased, but that along with these changes we have a large venom gland. Lastly in the Solenoglyphians we have a small lachrymal, while the labial glands may even disappear, or be but slightly represented, but that we have a very much larger venom gland than is found in any of the other forms.

What conclusions do these facts tend towards? That since the non-venomous snakes are so plentifully supplied with glands about the mouth, whose function, it is generally conceded, is mainly that of lubricating the prey, how does it come about that the venomous snakes lubricate their prey, and yet have but slightly developed labial, lingual, and lachrymal glands? The answer will fall under one of these heads. Firstly, that the glands are sufficient for the purpose; secondly, that there are mucous glands diffused throughout the mouth; or thirdly, that the venom gland aids in the lubrication. In answer to the first proposition, we maintain that the glands are not sufficient for the purpose, for while moderately well developed in some venomous forms, they are abortive or almost so in others. To the second question, as to the presence of diffused mucous glands, we are not aware that they have been described. To the third question we now come with considerable diffidence. We are fully aware how much has been written against the view that the venom gland is a salivary gland in function, but we nevertheless incline to the belief that, not only does the venom serve to lubricate the prey, but that it even helps to digest it.

It is not our intention to go into this subject in this paper, but out of the many facts that we might urge in support of our view, we will take a single one as the result of our own experiments.

The experiment, we have since learnt, had been tried by Weir Mitchell some years ago. He says: "The final influence of venom upon the muscular structure was extremely curious. In every instance it softened it in proportion to the length of the time during which it remained in contact with it, so that after even a few hours in warm-blooded animals, and after a rather longer time in a frog, the wounded muscle became almost diffluent, and assumed a dark colour and somewhat jelly-like appearance." Our experiments were mostly on fresh muscle, and in all cases the peculiar softening alluded to by Mitchell occurred, and the muscle could be easily broken up into a somewhat granular-like mass. We cannot say that the changes that take place are those of digestion, but the fact remains that the muscle is profoundly altered from a physical point of view; and if the change is not one of direct digestion, it nevertheless aids that process by the altered condition.

The most obvious objections to be urged against these views are, that a large quantity of the venom would be necessary, and that such a quantity would endanger the life of the snake.

We admit that the first objection is a strong one; with regard to the second, as to the effect of the venom on the snake itself, the results of the various investigators are so contradictory that the objection for the present must remain unanswered.

The Mechanism of the Bite.

In considering the various points connected with the bones and muscles in the mechanism of the bite of venomous snakes, we enter upon a field which has been gone over many times; and yet we think that there is room for new observations. Weir Mitchell has given an excellent account of the mechanism of the bite in his paper on *Crotalus;* but he nevertheless has missed several important points; and, in addition, he himself admits that he has not given an account of all the muscles concerned in the various movements; and lastly, the nomenclature which he has applied to the muscles and bones concerned, is in many instances quite different to that which we shall adopt.

We shall consider the bones which take part in the erection of the fangs.

The prefrontal is hinged to the frontal by a ginglymus joint. This joint is so constructed that the prefrontal may have an up-and-down movement. Owing, however, to the anterior face of the frontal running from within, outwards, and backwards, the prefrontal moves upwards and outwards, the lower portion coming also forward. This lower border rests on the superior surface of the maxilla which is, however, only slightly concave. Usually in venomous snakes there is a well marked ball and socket joint developed between these two bones, and accordingly considerable motion is possible ; but in the case of *Acanthophis* the greatest movement takes place between the frontal and prefrontal. This probably misled Krefft when he described the fangs as being permanently erect. The transpalatine articulates with the posterior extremity of the maxilla by a concavo-convex surface, while it is immovably fixed to the pterygoid by its posterior extremity.

The palatine is fixed to the anterior extremity of the pterygoid by a ginglymus joint which allows considerable upward movement. The pterygoid is loosely attached to the articular and quadrate by ligaments, but there is not that close adhesion of the bones that is said to occur in *Crotalus*, for instance.

The mandible is attached to the quadrate by a ginglymus joint, closely resembling that of the human elbow. The quadrate stretches outwards, backwards, and slightly downwards, so as to carry the posterior extremity of the mandible from the middle line. The superior extremity of the quadrate articulates with the squamosal by a large flattened surface, which allows of moderate movement. The squamosal is firmly fixed to the side of the skull, and is capable of only slight, if any, movement.

The digastric acting on the posterior extremity of the mandible in such a manner that the jaw is turned into a lever of the first order. Owing to the length of the mandible from its anterior extremity to the articular surface, and the shortness of the posterior portion to which the muscle is attached, extended movement is gained with loss of power. When, however, the mouth is closed by bringing the mandible upwards, the lever is of the third order, great power being gained by the insertion of the muscles along the upper and middle portions of the bone.

Since the mandible is carried outwards posteriorly, while it is close to the middle line in front, it follows that, when the mandible is depressed anteriorly, it will move downwards, outwards, and backwards, and by this means a wide gape is attained ; this is aided by the fact that the mandible is concave above from before back.

With regard to the movements of the head on the atlas we have seen that, while downward movement is easy, upward movement is limited by the close apposition of the exoccipital to the atlas. This is a decided advantage, for the snake when striking is able to steady its head against the atlas by contracting the dorsal muscles prolonged on to the skull. And again, since the muscles which enable it to strike are attached to processes on the basioccipital, it follows that the head is acted on like a lever of the second order, the fulcrum being at the anterior face of the atlas ; thus dislocation downwards of the occipital condyle is prevented by resting on the flat surface of the atlas, and by the exoccipitals meeting the anterior borders of this bone in the manner described above.

We now come to a point which is of considerable interest. Huxley and many others have described the erection of the fangs as the result of the action of the quadrate on the pterygoid bone, leaving out of the process the action of the special muscles which we have described above. Huxley says :—"When the animal opens its mouth for the purpose of striking its prey, the digastric muscle pulling up the angle of the mandible, at the same time thrusts the distal end of the quadrate forward. This necessitates the pushing forward of the pterygoid, the result of which is twofold ; firstly, the bending of the pterygo-palatine joint ; secondly, the partial rotation of the maxillary upon its lachrymal (pre-frontal) joint, the hinder edge of the maxillary being thrust downwards and forward. In virtue of this rotation of the maxillary through about a quarter of a circle, the dentigerous face of the maxilla looks downwards and even a little forward, instead of backwards, and the fangs are erected into a vertical position."

While we agree with the above description in regard to the actual movements of the bones, we unhesitatingly say, that the supposed means by which these movements are brought about are not the true ones, but that the fangs are erected through the action of special muscles on the pterygoid bones. The observations of Weir Mitchell on this point entirely agree with our own, namely, that the mandible may be depressed and the mouth opened to any width without necessitating the erection of the fangs. He has further shown that by stimulating the special muscles attached to the pterygoid bones, erection of the fangs took place. Observations made on the dry skull are misleading, and tend toward the theory advocated by Huxley.

We will now follow the snake through those complex movements which take place when a prey is struck. A snake approaches its prey with movements which are almost imperceptible, since they are made of numerous small motions which are rendered possible by the great differentiation which has taken place in its body. When it deems that it is sufficiently close to its prey it begins the following movements :—the head and the anterior vertebræ are raised somewhat from the ground, and the head is brought back so that the exoccipitals are placed in apposition with the atlas, which in turn is jammed against the axis. This is brought about by the contraction of the dorsal muscles, which are produced on to the skull. At the same time some of the anterior vertebræ are so bent that they form a slight bow with the convexity forward.

While this has been taking place the digastric contracts, and pulling on the posterior extremity of the mandible, rotation takes place round the quadrato-mandibular joint, and the anterior portion of the mandible is depressed. The digastric is aided in this action by the depressor mandibulæ, and the costo-mandibulæ and mylohyoid attached to the inferior and anterior portion of the mandible. Along with the opening of the mouth the fangs are erected by the spheno-pterygoid and the parieto-pterygoid ; the one acting above, the other below, draw forward the pterygoid, which leads to the rotation of the maxilla and prefrontal, since the transpalatine attached to the pterygoid shares with this latter bone its forward motion, and consequently being also attached to the maxilla this bone moves slightly on the prefrontal, which in turn moves forward and upward, since it is articulated by a joint with the frontal.

Mitchell says that the spheno-pterygoid alone erects the fangs by acting on the pterygoid, but this is an error, as the parieto-pterygoid shares largely in this action.

The snake is now ready to strike. With head firmly fixed, mandibles depressed, and fangs erect, the blow is struck by the sudden contraction of the rectus capitis anticus group of muscles, which are attached to the processes on the basi-occipital, and also by the contraction of the sacro-lumbalis group prolonged to the side of the basioccipital. The fangs enter in a downward and outward direction, and the jaw is closed by the contraction of the masseter, temporal, external pterygoid, and parieto-mandibularis muscles, along with which action the poison is injected through the contraction of the masseter on the gland. The squeezing of the gland is brought about thus :—the superior, or superficial, portion of the masseter contracting, pulls forward the posterior extremity of the gland; this action, however, is opposed by the strong zygomatic ligament attached to the gland externally and posteriorly. If now the inferior portion of the masseter contracts, the gland will be pulled downwards; this is opposed by the suspensory ligaments and by the integument below and externally made tense by the contraction of the retractor oris muscle; and also by the internal pterygoid, which is now contracting in order that it may pull the fangs more deeply into the wound. Thus opposed on all sides the gland is squeezed by the masseter most effectually. Now that the fangs are deeply sunk in the wound, and the solid teeth of the palatine are also driven in, the snake, if it no longer wishes to hold its prey, proceeds to extricate its teeth. This is not always an easy matter, and frequently the head is rotated from side to side in order to loosen the too firm hold. This rotating action is evidently largely aided by the insertion of the longissimus and sacro-lumbalis groups in the skull. If, however, the snake can disengage itself without any difficulty, it does so by relaxing the internal pterygoid, and contracting the parieto-palatine muscle and the spinalis group; the latter pulling the head upwards and backwards, while the parieto-palatine tends to do the same for the palatine bone, which coming into contact with the maxilla helps to raise that bone, and so aids in extricating the fangs. When the fangs are once more free, the internal pterygoid contracts, and pulling back the transverse and pterygoid bones depresses the fangs; the parieto-palatine aiding in this by drawing back the palatine. The fold of mucous membrane which surrounds the fangs slips up to the base of the fangs when these are erected. When depressed the mucous folds again regain their former position. This is described in *Crotalus* as being brought about by a slip of muscle from the pterygoid being attached to the folds. In *Acanthophis*, however, the parieto-palatine sends forward a slip which aids in this action. The chief element, however, appears to be some elastic fibres which are contained in the membrane, and when the fangs are erected these are put on the stretch; but when the fangs are depressed the fibres assume their former state, and so the membrane is brought back over the fangs.

In the non-venomous snakes the muscles attached to pterygoid bones and palatine act so as to draw the bones forward or backwards, as the case may be. By this means the prey is drawn gradually into the mouth.

Movements of the Vertebræ.

In regard to the movements of the spinal column, we have to deal with no less than ten articular surfaces for each vertebra. Two each on the zygosphene and zygantrum, two pre- and post-zygapophyseal, and the ball and socket of the centrum.

Taking two vertebræ that are articulated to one another, we see the postzygapophysis of the anterior resting on the prezygapophysis of the posterior, the zygosphene of the second with its facets in the zygantrum of the first, and lastly, the ball of the anterior resting in the socket of the posterior.

If now the anterior one be moved so that its front portion turns to the left, while its hinder extremity goes to the right, we shall observe the following order of events:—the postzygapophysis of the right side moves outwards and forwards; this brings the articular facet, with the projection on its posterior edge, (*vide supra*) forward, so that the facet rests mainly on the projection on the anterior edge of the prezygapophysis beneath. There is no obstacle to the movement of this zygapophysis in an outward direction beyond that offered by the ligaments. Meanwhile the postzygapophysis on the left side has moved inwards and backwards. This brings the facet, with its projection on the posterior edge, backwards and inward, and the projection now coming into contact with the sides of the lamina prevents any further movement in that direction. If we had had another vertebra in front of our anterior one, we of course would have found that it was the right anterior zygapophysis that was stopped in its motion by coming into contact with the pedicle of the front vertebra.

Thus if we represent the points of movement as taking place at the angles of a square, we shall see that at the two extremities of one diameter we have an obstacle to further motion, while at the extremities of the other diameter we have comparative freedom.

To these considerations we must now add the movements of the zygosphene and zygantrum. With regard to these, the same side that received a check above, will receive one now. And if we add to this the opposition afforded by the ball and socket joints of the centrum, we shall see that whenever one vertebra of a series moves from side to side, its movement becomes limited by bone in four places, and by ligaments in ten, or in other words we have dislocation opposed at fourteen points.

Vertical movement.

The middle one of three vertebræ is prevented from moving in a vertical direction to any great extent by the following surfaces. Anteriorly we have the zygosphene in its firm zygantrum, and also the prezygapophyses lying beneath the postzygapophyses of the preceding vertebra. Lastly, we have the ball and socket joint of the centrum. Thus we have five bony surfaces opposing vertical movements anteriorly. On the other hand we have only three opposing its movement downwards. To compensate for this, we have the mechanical advantage of the ball and socket joint alluded to in describing the centrum. Posteriorly we have five surfaces opposing movement downwards, and three upwards. The reason for this appears to rest in the fact that the spinalis dorsi, semispinalis, and multifidus all run from behind forward, and consequently when these muscles act they tend to pull the vertebræ upwards and backwards, or in other words to cause them to rotate round an axis placed at right angles to the long axis of the body; consequently the anterior portion of each vertebra will be raised and the posterior will then endeavour to rotate, and thus we have the five bony surfaces of each end of the vertebra to resist the contractions of these muscles.

Classification.

As regards the classification of *Acanthophis* we have come to the conclusion that its correct position is among the *Elapidæ*. In external appearance it bears a strong resemblance to a viperine snake, and even the osseous elements of its skull tend to approach the *Solenoglyphians*. But when we examine the maxillary bone we are no longer in doubt as to its real position. This bone has undoubtedly the characters of the maxilla of the *Proteroglyphians*. There are a number of anterior grooved fangs succeeded by a number of small solid teeth. The size of the fangs is greater than that usually found in the *Elapidæ*, but this only corresponds to the great strength of the bones composing the cranium; while the venom gland also appears to be larger, both absolutely and in proportion, than is usual in the *Elapidæ*.

It would seem as if we had here a case of mimicry; one of the *Elapidæ* taking on the external form of a viper, and with this undergoing some slight internal modifications, but still remaining undoubtedly among the *Proteroglyphians*. Or we may have in *Acanthophis* a link between the venomous colubrine snakes and the vipers.

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EXPLANATION OF PLATES.

References to Bones.

A.—Articulare. *B.S.*—Basisphenoideum. *B.O.*—Basioccipitale. *D.*—Dentale. *Ex.O.*—Exoccipitale. *E.O.*—Epioticum. *F.*—Frontale. *Fg.*—Fang. *H.*—Hyoideum. *L.P.*—Lateral plate of parietal. *M.*—Maxillare. *N.*—Nasale. *O.O.*—Opisthoticum. *P.*—Parietale. *P.F.*—Postfrontale (Postorbitale). *Pl.*—Palatinum. *P.M.*—Præmaxillare. *Pr.O.*—Prooticum. *Pr.F.*—Præfrontale (anteorbitale). *P.S.*—Parasphenoideum. *Pt.*—Pterygoideum. *Q.*—Quadratum. *S.*—Squamosum. *S.M.*—Septomaxillare. *S.O.*—Supraoccipitale. *S.T.*—Sella turcica. *T.C.*—Trabeculæ cranii. *Tr.*—Transversale (transpalatinum).

References to Muscles.

A.T.—Temporalis anterior. *C.C.M.*—Costo-mandibularis. *C.M.*—Cerato-mandibularis. *D.*—Digastricus. *D.C.*—Depressores costarum. *D.M.*—Depressor mandibulæ. *Ex.O.*—Externus obliquus. *Ex. I.*—Externi intercostales. *Ex.I.'*—Externi intercostales (straight bundles). *G.H.*—Genio-hyoideus. *G.H.G.*—Genio-hyo-glossus. *G.T.*—Genio-trachealis. *I.M.*—Intermandibularis. *I.O.*—Internus obliquus. *I.O.T.*—Tendon of internus obliquus. *I.P.*—Internus pterygoideus. *L.C.I.*—Levatores costarum interni. *L.D.*—Longissimus dorsi. *L.D.'*—Longissimus dorsi (deeper portion). *L.G.*—Lingual gland, (compressor band). *M.*—Masseter. *M.H*—Mylohyoideus. *M.S.*—Multifidus spinæ. *P.C.S.*—Pretrahentes costarum superiores. *P.C.I.*—Pretrahentes costarum inferiores. *P.M.*—Parieto-maxillaris. *P.Pt.*—Parieto-pterygoideus. *P.P.*—Parieto-palatinus, *P.T.*—Post-temporalis. *P.Ex.*—Pterygoideus externus. *R.C.*—Retractores costarum. *R.C.A.*—Rectus capitis anticus. *R.M.*—Rectus. *R.O.*—Retractor oris. *R.Q.*—Retractor quadrati. *S.D.*—Spinalis dorsi. *S.S.D.*—Semispinalis dorsi. *S.L.*—Sacro-lumbalis. *S.P.*—Spheno-pterygoideus *S.O.A.*—Suboccipito-articular. *S.R.*—Subvertebral rectus. *S.V.*—Spheno vomerine. *S.*—Scalenus. *Tr.*—Transversalis (inner bundles). *Tr.'*—Transversalis (outer bundles). *T.T.*—Transversalis (tendon).

Fig. 1.—The parietal bone. The superior surface is represented with its three areas. The middle triangular one being subcutaneous, the lateral ones giving attachment to the masseter and temporal muscles. *(X)* is the anterior extremity, which articulates with the frontal bones. *(A.L.)* antero-lateral edge, articulates with postorbital bone. *(M.L.)* the median lateral. *(P.L.)* the postero-lateral. *(Py.)* is the well marked process which gives attachment to the parieto-maxillary muscle. *(L.P.)* lateral plate of the parietal. *(P)* the posterior extremity which articulates with the supraoccipital.

Fig. 2.—The parietal bone. The inferior surface is represented together with the lateral plate. *(L.P.)* the lateral plate is seen to have an anterior depression, which is portion of the orbital fossa ; while there is also a posterior depression, which gives attachment to the parieto-pterygoid and parieto-palatine muscles. *(O.S.)* is the position of the orbitosphenoid bone, helping to form the anterior portion of the orbital fossa. Between the lateral plates below, the basi- and parasphenoid bones fit ; while the prootic joins its postero-lateral margin. *(O.F.)* is portion of the optic foramen.

Fig. 3.—The frontal bone with the vertical septum of bone *(V.S.)*

Fig. 4.—Postorbital bone, showing its twisted nature. To the inferior portion of this bone the fascia of the venom gland is attached as a special ligament.

Fig. 5.—The basisphenoid *(B.S.)* and parasphenoid bones united. The inferior surfaces are displayed showing the excavated parasphenoid, with a trabecula cranii on either side *(T.C.)*. Posteriorly the prominent keel of the basisphenoid is seen, while on either side of this the bone is excavated to give attachment to the spheno-pterygoid muscle. *(Px.)* is the process which articulates with the inferior surface of the basioccipital.

Fig. 6.—The superior surface of the para- and basisphenoid bones. *(S.T.)* the sella turcica.

Fig. 7.—The basioccipital bone ; the inferior surface. The anterior portion has an excavated area which articulates with the basisphenoid. Four prominent spinous processes are seen, which give attachment to the rectus capitis anticus, and the tendon of the sacro-lumbalis *(S.L.)*

Fig. 8.—The bones of the upper jaw ; external surfaces. *(M.)* The maxilla carrying three perforated fangs in front, and three solid teeth behind. *(Tr.)* the transpalatine with the well marked process *(P.C.)*, which gives attachment to the internal pterygoid muscle. *(Pl.)* the palatine carrying solid teeth. *(Pt.)* the pterygoid with solid teeth.

Fig. 9.—Superior surfaces of same bones. The concavo-convex joint between the maxilla and transpalatine is seen ; also the excavated internal edge of the maxilla. The surface of the pterygoid is seen which gives attachment to the parieto-pterygoid and spheno-pterygoid muscles.

Fig. 10.—Inferior surface of the same bones ; the excavated surface of the pterygoid is seen which gives attachment to the internal pterygoid muscle.

Fig. 11.—The prefrontal *(Pr.F.)* is seen, and on its superior edge is a well marked hinge-joint *(H.J.)*, which articulates with the frontal. The articulating surfaces between the prefrontal and the maxilla are seen to differ from that present in most venomous snakes.

Fig. 12.—The skull viewed from above. On the right side the postfrontal and the prefrontal have both been removed.

Fig. 13.—Muscles of the head from above. On the left side the masseter has been drawn aside, and the attachment of its superficial fibres to the posterior portion of the venom gland (*V.G.*) is shown. (*M.'*) is the deeper portion of the masseter, which chiefly goes to the lower jaw. The anterior temporal (*A.T.*) is displayed. (*Z.L.*) is the zygomatic ligament attached to the venom gland. (*Pt.*) are the fibres of the platysma spreading out to be lost anteriorly. The retractor quadrati is seen passing back beneath the retractor oris, but above the depressor mandibulæ. On the left side the spinalis dorsi has been removed, and the semispinalis is seen attached to the skull.

Fig. 14.—The muscles of the head are seen from the side. The retractor oris (*R.O.*) is reflected, and the depressor mandibulæ is pulled aside. The attachment of the superficial portion of the masseter to the gland is seen, while the attachment of the masseter, posterior temporal, and internal pterygoid to the lower jaw is also seen. (*S.L.G.*) the superior labial gland. (*I.L.G.*) the inferior labial. (*V.D.*) the venom duct.

Fig. 15.—The masseter has been removed from the venom gland, and the parieto-mandibular (*P.M.*) is displayed, as also is the anterior temporal (*A.T.*); the lachrymal gland (*L.G.*) is seen. (*V.D.*) venom duct.

Fig. 16.—The venom gland has been removed. The slender parieto-maxillary is seen, and the attachment of the anterior temporal to the lower jaw. The posterior temporal has been reflected, and the external pterygoid displayed. The parieto-pterygoid (*P.Pt.*) is also seen, and the insertion of the internal pterygoid on the transverse bone.

Fig. 17.—The temporal muscles have been removed, and the whole of the lower jaw. The parieto-mandibular is seen springing from the prominent process of the parietal. The parieto-pterygoid (*P.Pt.*) and spheno-pterygoid are seen attached to the pterygoid bone. $5''$, $5'''$ branches of the fifth nerve emerging from the foramen ovale. (*Q.B.*) portion of the quadrate bone.

Fig. 18.—The parieto-pterygoid and spheno-pterygoid muscles have been removed, and the parieto-palatine displayed. (*S.O.A.*) the sub-occipito-articular (Dugès). (*L.D.*) longissimus dorsi attached to skull. (*S.L.*) sacro-lumbalis attached to basioccipital. (*R.C.A.*) rectus capitis anticus attached to basioccipital and exoccipital bones.

Fig. 19.—Inferior surface of the head. On the right side of figure the mylohyoid has been removed, and the membrane lining the floor of the mouth is shown. (*T.C.*) trachea. Anteriorly portion of the intermandibularis is removed; the lingual gland (*L.G.*) with its band of muscle is seen. The attachments of the genio-hyoglossus and genio-trachealis are also seen. The genio-hyoglossus is shown to have a bifurcated attachment; one tendon being attached to the tendon of the intermandibularis in the midline; while the other is inserted into the inner side of the dentary. The attachment of the cerato-mandibularis has been cut; it runs forward and joins the tendon of the intermandibularis; posteriorly it lies along the lower jaw. The mylohyoid (*M.H.*) is seen to be attached to the bony hyoid (*H.*) internally, while anteriorly it is attached to the lower jaw. (*T.I.—T.I'.*) are the tendinous intersections which represent ceratohyal and hypohyal (*T1.*), and the first branchial bar (*T'*). The portion (*H.*) represents the hypobranchial portion of the hyoid. (*G.H.*) are the genio-hyoid muscles arising posteriorly from the hyoid bars. (*J.H.*) the junction of the hyoid bars (basihyal plate).

Fig. 20.—The intermandibularis (*I.M.*) is shown giving off (*IM′.*) a slip to the integument (*C.M.*); the cerato-mandibularis joins the intermandibularis in front. (*I.L.G.*) inferior labial gland.

Fig. 21.—The costo-mandibular (*C.C.M.*) is seen running forward to join the depressor mandibulæ (*D.M.*) to form the mylohyoid (*M.H.*). On the left side of the figure the mylohyoid has been removed, and we see the masseter (*M.*), posterior temporal (*P.T.*), and internal pterygoid (*I.P.*). The external intercostals are seen, and the scalene muscles, while the rectus capitis anticus (*R.C.A.*) lies still more deeply.

Fig. 22.—The lower jaw has been removed. On the left side we have the internal pterygoid reflected, and the parieto-pterygoid and spheno-pterygoid displayed. On the right side of the figure we have the internal pterygoid, and the aponeurosis of the roof of the mouth (*P.A.*). Anteriorly we see the small spheno-vomerine muscle (*S.V.*).

Fig. 23.—The muscles composing the greater portion of the erector spinæ. The spinalis dorsi is seen to lie next the spinous processes (*S.*) and to break up into tendons which run forward to be inserted in the spines (*S.*). The tendons of these muscles are intimately connected and form a distinct aponeurosis. (*L.D.*) the longissimus dorsi group; the superior layer is seen to give off tendons which run outwards and form the tendons of origin of the sacro-lumbalis group. The inferior tendons run inwards and join with the tendons of the spinalis dorsi group.

Fig. 24.—(*S.L.*) the sacro-lumbalis column, arising in part from the longissimus dorsi column, and inserted along with the tendons of the pretrahentes costarum superiores (*P.C.S.*). Between the tendons of the latter muscles are the tendons of the external oblique (*Ex.O.*).

Fig. 25.—The muscles on the lateral aspect of the snake's body. The tendons of the sacro-lumbalis (*S.L.*) are seen to be inserted into the ribs along with the tendons of the pretrahentes costarum superiores (*P.C.S.*). The external oblique (*Ex.O.*) is seen to be composed of bundles intimately connected with the rectus (*R.M.*). The internal oblique springs from the costal cartilages as "leaves" of muscles, and running forward these are attached to the spaces between the scutal muscles (*S.M.*). A tendinous band (*I.O.T.*) continues the muscle towards the midline where it joins the tendon of the transversalis (*T.T.*). The fibres (*Ex.I′.*) are modified external intercostal muscles.

Fig. 26.—The muscles in the interior of the snake's body. By the mid-line we have the subvertebral rectus (*S.R.*) and the depressores costarum (*D.C.*). On the left side of the figure levatores costarum interni (*L.C.I.*), separated from the subvertebral rectus by the intercostal nerves (*I.N.*).

Fig. 27.—The depressores costarum (*D.C.*) are seen running forward to be modified so as to form a rectus capitis anticus major (*R.C.A.*), and at the same time representing the longus colli muscles. The most anterior bundle of the sacro-lumbalis column (*S.L.*) is seen to pass forward to be inserted on the basioccipital (*B.O.*), while the upper division of the rectus capitis anticus runs outwards and is inserted on the exoccipital. The scalene (*S.*) muscles are represented by the continuation of the external intercostal group on to the anterior vertebræ.