centra with the fundamental body metamerism, as shown by the neuro-muscular segments; *e.g.* there are frequently in the caudal region in sharks (3) two centra to each neuro-muscular segment, while in part of the trunk in Notidanidae one centrum corresponds to two neuro-muscular segments.

The chondrocranium retains through life its primitive character. The ethmoidal region is prolonged forwards into a *rostrum—*which may be of enormous size *{Pristis),* or may be of insignificant dimen- sions as in most sharks.

The jaw apparatus is also remarkably archaic: the functional jaws being the *palatopterygoquadrate* cartilage and Meckel’s cartilage respectively. The suspension from the skull is typically *hyostylic,* except in *Notidanus* where it is *amphistylic,* in the *Holocephali* where it is *autostylic,* and in *Heterodontus* where it approaches the autostylic condition.

The skeleton of the postmandibular visceral arches consists of a halt hoop of cartilage on each side divided into a number of segments: the two half hoops are connected ventrally by a median *copula (basikyal,* or *basibranchial).* The hyoid arch most usually shows a division into a dorsal (*hyomandibular)* and a ventral (*ceratohyal)* element, and except in the Notidanidae the dorsal segment is of large size in correlation with its function in the suspension of the jaws. This enlargement of the hyomandibular is particularly marked in the case of the Rays *{Raia)* where it may become freed from the ventral segmented part of the arch which articulates directly with the skull. The branchial arches usually are segmented on each side into four pieces (*pharyngobranchial, epibranchial, ceratobranchial* and *hypobranchial)* in addition to the median copula.

All these visceral arch skeletons bear on their outer surface a number of cartilaginous rays which radiate outwards and support the gill septa. Those attached to the hyoid arch (*branchiostegal* rays) show by their specially large size a foreshadowing of the development of the operculum of the higher group of fishes.

In addition to the elements already mentioned slender cartila­ginous rods of doubtful significance are found superficial to the jaw cartilage (*labials)* and to certain of the branchial arches (*extra branchials).*

The limb girdles of the Selachians are very simple—a hoop of cartilage incomplete dorsally in the case of the pectoral, a transverse bar of cartilage in the case of the pelvic girdle.

In the ancient Pleuracanthids the two halves of the pectoral girdle remained distinct in the adult, and each was segmented into three pieces, thus showing a remarkable correspondence with the visceral arches lying in front of them. (For the bearing of this on theories of the origin of limbs see Ichthyology : *Anatomy.)* In some existing sharks (*e.g. Acanthias)* a relic of this condition is found—the dorsal extremity of the girdle being segmented off from the rest.

The cartilaginous skeleton of the pectoral limb consists of numerous cartilaginous rays which typically are connected with the girdle through the intermediary of three basal pieces known as *propterygium, mesopterygium* and *metapterygium.* In the Rays, in correlation with the gigantic development of the pectoral fins, the propterygium and metapterygium become greatly enlarged in an anteroposterior direction—the former becoming attached to the side of the cranium or even meeting and fusing with its fellow in front (*Trygon).* In the pelvic limb the rays are—except a few in front—borne on the outer side of a single backwardly projecting basal piece (*metapterygium).* In the male this is continued backwards to form the skeleton of the clasper.

The limb skeleton shows remarkably interesting features in the ancient extinct sharks *Cladoselache* and *Pleur acanthus.*

The placoid or bony skeleton is seen in its most archaic form in Selachians in the form of superficially placed placoid scales. These may be uniform in size forming the characteristic shragreen of the various sharks, or scattered scales may be greatly enlarged as in the thornbacks, or finally the scales may have completely atrophied as in the electric ray (*Torpedo).*

Local placoid elements or aggregations of placoid elements may become specially enlarged to form defensive or offensive weapons. In the sawfish *{Pristis)* a row of greatly enlarged placoid spines along each side of the rostrum form the “ teeth ” of the saw, and a similar condition occurs in the sharks of the genus *Pristiophorus.* In the sting-rays the tail is armed with a large serrated spine taking the place of the dorsal fin and having behind it smaller spines, the front one of which increases in size and becomes functional if the previously functional spine is broken off.

The portion of skin involuted to line the buccal cavity carries with it its armature of placoid scales (*Chlamydoselachus).* Normally these undergo atrophy except near the margin of the cavity where they are greatly enlarged to form the teeth. These vary greatly, as might be expected, in accordance with the nature of the food—they may be sharp prehensile spines, or triangular cutting blades with serrated edges (*e.g. carcharodon* and other sharks) or flattened plates adapted to crushing Molluscan shells *{e.g.* various rays).

*Vascular System.—*The heart possesses a single atrium and a single ventricle. Opening into the atrium is a well-developed sinus venosus and leading from ventricle into ventral aorta is a well-developed rhythmically contractile conus arteriosus, containing a complex arrangement of pocket valves. These pocket valves are arranged in longitudinal rows, each row representing the remains of a longi­

tudinal ridge in the conus of the embryo. The valves of each row tend to become differentiated in size, *e.g.* in *Rhina* the anterior valve in each row is considerably enlarged. Finally a condition may be reached in which all the valves of the row disappear except two as in *Scyllium canicula.* As regards the remaining parts of the blood- vascular system, probably the most characteristic feature is the tendency seen in various Selachians for the main venous trunks (cardinals and hepatic veins) to become dilated at their front ends into a special sinus which fills the cavity of the orbit. The kidneys are provided with a well-developed renal portal system.

*Nervous System.—The* brain of the Selachians shows a mixture of primitive and specialized characters. The hemisphere region is remarkable for the indistinctness of the two hemispheres. This has been looked on by some, *e.g.* Gegenbaur, as a primitive feature, the hemispheres haying not yet been developed. To others, including the writer of this article, the balance of evidence seems in favour of the condition in Selachians being due to a secondary disappearance of the separation between the two hemispheres. In such comparatively primitive forms as the Notidanidae the paired character of the hemisphere region is still clearly indicated. In the Raiidae on the other hand even the lateral ventricles have lost their paired character, while in *Myliobatis* the ventricle of the region has dis­appeared entirely, leaving a solid unpaired mass. Although the hemisphere region has in great part lost its paired character, this does not apply to the anterior outgrowths from the hemispheres, the olfactory lobes. In the Holocephali the olfactory lobes remain close to the hemisphere surface. In other Selachians, however, the olfactory organ, with the olfactory lobe attached to it, becomes carried away by differential growth to a lesser or greater distance from the hemisphere. The result is that the middle part of the ol­factory lobe becomes greatly drawn out *{Olfactory tract* or *peduncle).* The swelling at its anterior end is now spoken of as the olfactory lobe, while its hinder end, where it passes into the brain, is the *olfactory tubercle.*

In the region of the thalamencephalon there is a well-developed infundibular gland, and the pineal body is present in the form of a greatly elongated slender tube which passes upwards and forwards to end in contact with the cranial roof about the level of the anterior boundary of the hemisphere region. The pineal body ends in a small bulbous enlargement but shows no trace of eye structure. In the mesencephalon are a pair of well-developed optic lobes.

The cerebellum is highly developed—as in the case of other fishes which perform active and complex movements. The medulla oblongata shows a characteristic feature in *Torpedo,* where the nucleus of origin of the electric nerves forms a large swelling on the floor of the fourth ventricle on each side of the mesial plane. In connexion with the organs of special sense in the Selachians, there are various points of general interest. In various forms, *e.g. Scyllium* and *Raia,* the olfactory organ is connected with the mouth by means of an open gutter—the oronasal groove—in which we may probably see the homologue of the similar groove which appears in the embryo of the higher vertebrates and which, becoming covered in, gives rise to the communication between nose and buccal cavity *via* the internal nares. The *otocyst* or auditory organ, which arises in ontogeny as an involution of the ectoderm, is remarkable in the Selachians from the fact that it does not become completely enclosed. Throughout life the ductus endolymphaticus remains open to the exterior by a minute pore on the dorsal side of the head. In *Rhina* (4) this communication of otocyst with exterior is relatively wide, and through it grains of sand gain admission to the interior of the otocyst, where they take the place functionally of the small calcareous *otoconia* of other forms.

*Cutaneous Sense Organs.—*As in other fishes there is a rich development of sense buds scattered over the general surface of the head and body. Certain of these retain their superficial position through- out life, while others are carried inwards by involution of the ecto- derm so that they come to be sunk in pits. These pits may become prolonged into tubes with dilatations at their inner ends containing the sense buds (“ Ampullae of Lorenzini ” of the head region), or their external opening may be narrowed to a fine slit, or they may become completely shut off from the exterior (“ Savi’s vesicles ” on ventral side in *Torpedo).* Another series of these cutaneous sense buds is arranged in rows on the head and trunk to form the character­istic organs of the lateral line. These are innervated by the *lateralis* system of nerves. These organs, like the sense buds already mentioned, become sunk beneath the surface, lying first in the floor of an open groove *{Chimaera)* and later, as this becomes covered in, in a canal which opens to the exterior at intervals by pores.

*Ontogenetic Development.—*The Selachians possess large heavily yolked eggs and show corresponding modifications in their develop­mental processes. Segmentation is partial, resulting in the formation of a blastoderm. The process of gastrulation is much less modified than in the Sauropsida (where similar conditions prevail as regards quantity of yolk), and can be readily compared with the method seen in the larger types of holoblastîc egg.

Fertilization is internal, the myxipterygia or claspers serving as intromittent organs. On its passage down the oviduct the egg normally becomes surrounded by a layer of albumen and by a tough external envelope of flattened quadrangular shape. The comers of the external capsule may be produced into points (*Raia)* or into long