connected with the cranium, and applied to aid nutrition in the form of deglutition or respiration; such skeletal parts are the jaws and arches (or parts of such) behind the jaws known as the hyoidean and branchial arches.

1. *The Cartilaginous Cranial Skeleton.—*This is formed “ by a differentiation within the membranous cranium,”@@1 and consists of two plates (parachordals) placed one on each side of the anterior part of the notochord, and forming with the latter the floor of the hinder part of the cranium, which part is known as the basilar plate. The carti­laginous auditory capsules are closely united to the outer sides of the basilar plate. From the anterior margin of that plate two bars, called the “ trabeculæ,” diverge for­wards from the anterior end of the notochord, and then approximate, so as to enclose what is known as the pituitary space, and also the floor of the anterior part of the cranium. Thence they advance (generally united) into the nasal or ethmoidal region of the skull, forming a median nasal septum, having a cartilaginous olfactory capsule on each side of it, and developing lateral pro­cesses in front of and behind those capsules. Only in the *Cyclostomata* is there a single olfactory capsule instead of a pair. The nature of the parachordals and trabeculæ is disputed, but opinion inclines to regard them as corre­sponding to the neural arches of the spinal skeleton,— except the part around the notochord, which corresponds with centra in an unsegmented condition.

Upgrowths arise on the outer side of each parachordal, and these meet above and thus form a complete dorsal arch in the hinder or occipital region of the skull. The posterior aperture of this arch is called the occipital fora­men, and through it the spinal cord enters the cranium, there to expand and become the brain. Lateral plates arise on each side farther forwards, in the anterior or sphenoidal region of the cranium. But these do not gene­rally ascend enough to unite together dorsally, at least they almost always form but an imperfect roof to the cranial cavity. This cranial aperture may be related to a median, dorsally placed, eye, which probably once existed in all Vertebrates, and still exists in a rudimentary condi­tion in many Lizards.@@2 The lateral plates grow together medianly in front, and more or less completely separate the cranial cavity from the ethmoidal region in front of it. Openings are left here and there in the cartilages of the cranial walls for the passage outwards of nerves from the central part of the nervous system ; but these openings or foramina will be noticed in describing the osseous cranial skeleton. On each side of the sphenoidal region are the optic cartilaginous capsules, which, however, never become united (as do the others) with the cranium, and therefore are not generally reckoned as parts of the skull. A special median cartilaginous vertical upgrowth from the trabeculæ between these capsules may (as in Teleostean Fishes, Lizards, and Birds) form an interorbital plate beneath the most anterior part of the cranial cavity.

The third category of cranial skeletal parts is generally represented by a series of descending cartilaginous bars (or visceral arcs) on each side of the alimentary canal, running forwards beneath the cranium to terminate at the mouth.

As this lateral region of the head corresponds with the body wall behind it, and shows transitory indications of division (like the body wall behind it) into an inner part or splanchnopleure and an outer part or somatopleure, it is obvious that skeletal structures formed in its inner or outer part may be taken as belonging to different cate­gories. In the *Cyclostomata,* as in the Lamprey, we find cartilaginous bars placed in the somatic division exclu­

sively,—bars which support and externally protect the series of gill-pouches on each side ; and parts probably homologous with these somatic bars of the Lamprey are found also in some Sharks.

The Cyclostomes also possess complex labial cartilages which support the lips of their suctorial mouths. Re­presentatives of these cartilages are also to be found about the mouths of many Fishes, as well as in the temporary suctorial mouth of the Tadpole; and they still persist in connexion with the olfactory capsules, though in a reduced form, in higher animals.@@3 The most important members of the third category of cranial skeletal parts are—(1) the series of cartilaginous arches lying in the splanchnic or inner region of the lateral wall of the head, which arches sup­port the gill-pouches on their inner sides and are known as the branchial arches, and (2) the arches seemingly in series with them, which are more anteriorly placed, and which are known as the hyoidean arches and the jaws.

One or other, or both, of these two sets of arches are well developed in all craniate Vertebrates, except the Cyclostomes, in which there are no true branchial arches, but only a hyoidean and a rudimentary jaw arch. There may be as many as seven branchial arches *(e.g.,* in *Noti­danus),* but five are usually present in water-breathing Vertebrates. The hyoidean arch becomes segmented into two noteworthy portions, the upper of which is known as the hyomandibular portion.

The most anterior, or mandibular arch, also becomes segmented into an upper or metapterygoid portion, an inferior or Meckelian portion, and a median or pterygo- quadrate portion, which grows forwards in front of the metapterygoid portion, and forms the foundation of the upper jaw against which the lower jaw (formed from the Meckelian portion) bites.

The thus formed upper and lower jaws may come to be suspended from the cranium in one of three ways. (1) They may depend from the cranium directly, that is, with­out the intervention of the hyoidean arch; this arrange­ment is known as autostylic,@@4 and exists in all Vertebrates above Fishes, as well as in certain of the latter *(Chimæra* and the *Dipnoi).* (2) They may be suspended by the co-operation of the hyomandibular portion of the hyoidean arch with their own metapterygoid portion ; this arrangement is known as amphistylic, and is found in *Notidanus, Hexanchus,* and *Ostracion.@@*5 (3) They may be suspended exclusively by the hyomandibular portion of the hyoidean arch (to the exclusion of their more proximal portion), as in most Fishes and the Skates—an arrangement known as hyostylic.

2. *The Osseous Cranium.—*The bony skull is formed partly by ossifications of the cartilage of the cartilaginous skull and partly by ossifications of the membranes investing or completing it. The cartilaginous cranium may, as in Elasmobranchs, be covered by a thin calcified layer with­out becoming ossified. It may, as in the Selachian Ganoids, remain itself quite unossified, and yet become enveloped by membrane bones. In most cases, however, the investment of the cartilaginous cranium by membrane bones is accompanied by a more or less complete ossifica­tion of the cartilage itself. In the *Amphibia* the carti­laginous cranium is to a not inconsiderable extent ossified, but the membrane bones which invest it are nevertheless easily separable from it. The most constant ossifications of the cartilaginous cranium are in the occipital region. In the Lepidosiren these are the only ones, a bone being thus formed on each side of the occipital foramen, which bones are known as the exoccipitals.

@@1 Balfour, ii. p. 466.

@@2 See *Nature* of May 13, 1886, p. 33.

@@@3 Balfour, *loc. cit.,* p. 490.

@@@4 These terms were proposed by Professor Huxley. @@@5 Balfour, *loc. cit.,* p. 475.