Any hard structures formed in the walls of the alimentary canal—the lining of which is continuous at either end with the external skin—are to be reckoned as fundamentally exoskeletal. In the process of development the epiblast becomes inflected more or less into either extremity of the alimentary tube, but the intermediate portion, together of course with any hard structures de­veloped in it, is of hypoblastic origin.

In the great majority of Vertebrate animals the two layers of the skin, the epidermis and the dermis, are, as in man, soft, though locally provided with certain denser appendages, such as epidermal and dermal scales, hairs, nails, scutes, and teeth.

The soft, general exoskeleton or skin invests the body of Man pretty closely, though slightly projecting folds of it extend between the roots of the fingers and toes. In some abnormal cases these folds extend so far and bind the digits together so much that the thus malformed person is said to be “ web-fingered ” or “ web-toed.” Such a condition is found normally in many animals, as notably in Ducks and Geese, and such parts form a large portion of the “ wing ” of the Bat.

Other extensions of the skin of the body are note­worthy. Thus in the “ Flying ” Squirrels and Opossums, and the curious Rodent named *Anomalurus,* the skin of the sides, between the arms and the legs, is much expanded, serving for a parachute. There may be a skin parachute supported by long free movable ribs, such as we shall see exist in the little Lizards called “ Flying Dragons.” There may be a very remarkable extensive skin round the neck, as in the Frilled Lizard, and folds of skin may hang freely, as in the “ dewlap ” of Cattle, or may be formed here and there as in the Rhinoceros, the skin of which animal is so thick as to necessitate the existence of such folds to allow free movements to the body and limbs. Long filamentary processes may be formed along the back, as in the Iguana and various other Lizards.

In the Seals a fold of skin connects together the hind legs and the tail, and also in our common Bats, which have in addition their very elongated webbed fingers connected with the sides of the body and legs by another great fold of skin which, with those between the fingers, forms the entire bat’s “wing.”

The integument may be very distensible, as in those Fishes *(e.g., Diodon)* which distend themselves with air and then float belly upwards.

The epidermis of many Vertebrates, and of Man, is shed in minute fragments, constantly removed by friction and ablution, and constantly replaced ; only under abnormal conditions and after certain diseases does it come away in large and continuous patches. In some other Vertebrates, as notably in Snakes, the entire epidermal investment of the body, even that of the eyes, is cast off entire as one whole.

The epidermis never has its superficial layer connected with bone, but it often becomes thickened and horny, as we see in the sole of the foot, or the labourer’s hand, and in those abnormal thickenings called “ corns.” Certain local thickenings which are not abnormal may exist in animals ; such are the callosities on the inner side of the legs of the Horse, on the breast of the Camel, and on the nates of the lower Old-World Apes.

Of the appendages of the epidermis the most simple are scales, such as we find on the legs of Birds and the bodies of Serpents and Reptiles generally.

A *scale—*a true scale, such as those of Snakes and Lizards— consists of papillæ of the dermis invested by the epidermis, the whole being covered by a cornification of the external part of the epidermis. Scales may be very diverse in shape, prominence, and relative size, and may form very large plates. The so-called scales of Fishes are of deeper origin and are a form of scutes.

A *hair* differs from a scale in that, instead of being an epidermic investment of a dermal projection outwards, it originates by an

epidermal projection inwards into the subjacent dermis. A small papilla of the dermis, however, soon projects upwards, in turn, into the descending epidermal process, and then cornification sets in (at first in the immediate vicinity of the dermal papilla) in the cells around the axis of the epidermal descending projection, and this hardened portion soon projects beyond the surface of the body, while the part of the epidermis about its deepest part becomes modified into its so-called “root.”

A *nail* or *claw* arises as a cornification of the epidermis (but not of its deepest layer) lying upon numerous very vascular ridges (or transversely elongated papillæ) of the dermis, forming the primitive bed of the nail, and enclosed in a deep fold of the integu­ment. One end of the structure becomes free and projecting superficially, while the opposite region grows by epidermal additions from beneath and at its attached extremity.

A *feather* is more nearly related to a scale than it is to a hair. It consists at first of an upwardly-projecting dermal papilla invested with epidermis, and it is only at a later stage that its base sinks into a sack or “feather follicle.” The outermost layer of epi­dermis becomes converted into a horny sheath, which is thrown off when the feather is completed. The *quill* is formed by cornification of the deepest and more superficial layer of epidermis investing the base of the dermal and vascular papilla, and is open at both ends. The vascular papilla it encloses shrinks up when the feather is fully formed. The *vane* of the feather is formed from the more apical portion of the papilla, and its central part, or *shaft,* is con­tinuous with the quill, while ridge-like thickenings of epidermis diverging from either side of this central part constitute the barbs of the vane, from each of which yet smaller processes or barbules proceed.

A *scute* is a hardening of the outermost portion of the dermis, with an investment from the deepest layer of the epidermis. Such are the so-called scales of ordinary Fishes, which may be represented by the bony plates and processes called placoid scales—so common in the groups of Sharks and Rays. In these latter structures dermal papillæ appear and calcify, forming a dense structure with­out corpuscles, called dentine, beneath which may be a corpusculated structure of true bone. The calcifying papillæ receive an invest­ment of still denser calcareous tissue, called enamel, from the deepest layer of the epidermis. These placoid structures often come to project outwards on the surface of the body as long spines or as shorter tooth-like processes, or they may protect the surface of the body as flat plates. Often the dentine more or less entirely atrophies, so that the structure comes to be formed almost entirely of true bone or of that peculiar calcified tissue of which the scales of ordinary Fishes (such, *e.g.,* as the Perch and Carp) are composed.

A *tooth* is a structure closely related to a scute. It differs from the latter just as a hair differs from a scale—namely, by owing its origin to an ingrowth of the epidermis instead of merely to a primitive outgrowth of the dermis.

The so-called teeth of the Lamprey are not true teeth, but are merely horny epidermal structures essentially similar to scales.

In the origin of a true tooth a process of the epiblastic layer of the mouth—the buccal epithelium—grows into the subjacent dermis, and, assuming a cup-like form (with the concavity of the cup turned away from the epithelial surface of the mouth), a dermal papilla rises into the cup. The apex of this papilla then superficially calcifies into dentine, and becomes invested with a layer of enamel formed from the immediately adjacent surface of the epidermic cup or “ enamel organ.” An investment of connective tissue called the dental capsule becomes formed round the whole. The dentine then increases, a remnant of the papilla remaining as the “pulp.” The young tooth gradually approaches the buccal surface, and the base of the papilla becomes formed into the root or fang of the tooth. The enamel organ does not descend so far, but only invests the crown of the tooth. The inner layer of the capsule, however, investing the fang gives rise to a third dental tissue known as the cement. A bud may or may not be given off from the developing tooth to serve as its future successor.

Thus teeth are normally both epiblastic and mesoblastic struc­tures, but in certain Fishes they line parts of the throat (the branchial arches), the superficial membrane of which is derived from the hypoblast, and such may of course be considered as hypoblastic skeletal elements, and, thus considered, must be reckoned as constituting a separate category of teeth.

Such being the various kinds of dense structures which enter into the composition of the Vertebrate exoskeleton, each kind may be developed to a greater or less extent in different groups of Vertebrate animals.

*Exemplifications of Epidermal Skeletal Parts.*

*Scales* entirely clothe the bodies of most Lizards and Snakes and the legs of Birds. In Tortoises and Turtles they take the form of large plates, which in one species are known as tortoise-shell. The