as also their apparent termination in this part, each ultimate nerve appearing to terminate in the bottom of a tube or duct, the sides of which secrete and convey a thick mucus to the skin.” These “ nervo-mucous ” organs are found in the sides and under part of the head and on the fore part of the trunk.

The *Amphibia* and *Reptilia* do not show any special organs of touch. The lips of tadpoles have tactile papillæ. Some snakes have a pair of tentacles on the snout, but the tongue is probably the chief organ of touch in most serpents and lizards. All reptiles possessing climbing powers have the sense of touch highly developed in the feet.

Birds have epithelial papillae on the soles of the toes that are no doubt tactile. These are of great length in the capercailzie (*Tetrax urogallus),* “enabling it to grasp with more security the frosted branches of the Norwegian pine trees ” (Owen). It has been sug­gested that the delicate “papillose” digits of the smaller birds assist them in nest-building by having the sense of touch highly developed. Around the root of the bill in many birds there are special tactile organs, assisting the bird to use it as a kind of sensi­tive probe for the detection in soft ground of the worms, grubs, and slugs that constitute its food. Special bodies of this kind have been detected in the beak and tongue of the duck and goose, called the tactile corpuscles of Merkel, or the corpuscles of Grandry (fig. 2). Sim­ilar bodies have been found in the epidermis of man and mammals, in the outer root-sheath of tactile hairs or feelers. They consist of small bodies composed of a capsule enclosing two or Fig. 2. —Tactile Corpuscles from duck's tongue. more flattened nucleated *n*, nerve.

cells, piled in a row. Each corpuscle is separated from the others by a transparent protoplasmic disk. Nerve fibres terminate either in the cells (Merkel) or in the protoplasmic intercellular matter (Ranvier, Hesse, Izqui­erdo). Another form of end-organ has been described by Herbst as existing in the mucous membrane of the duck’s tongue. These cor­puscles of Herbst are like small Pacinian cor­puscles with thin and very close lamellæ. Developments of integument devoid of feathers, such as the “wattles” of the cock, the “ca­runcles ” of the vulture and turkey, are not tactile in their function.

In the great majority of *Mammalia* the general surface of the skin shows sensitive­ness, and this is developed to a high degree on certain parts, such as the lips, the end of a teat, and the generative organs. Where touch is highly developed, the skin, more especially the epidermis, is thin and devoid of hair. In the Monkeys tactile papillae are found in the skin of the fingers and palms, and in the skin of the prehensile tails of various species *(Ateles).* Such papillae also abound in the naked skin of the nose or snout, as in the shrew, mole, pig, tapir, and elephant. In the *Or- nithorhynchus* the skin covering the mandibles is tactile (Owen). In many animals certain hairs acquire great size, length, and stiffness. These con­stitute the vibrissae, or whiskers. Each large hair grows from a firm capsule sunk deep in the true skin, and the hair bulb is supplied with sensory nerve filaments. In the walrus the capsule is cartilaginous in texture. The marine *Carnivora* have strong vibrissae which “act as a staff, in a wayanalogous to that held and applied by the hand of a blind man ” (Owen). Each species has hairs of this kind developed on the eyebrows, lips, or cheeks, to suit a particular mode of existence, as, for example, the long fine whiskers of the night-prowling felines, and in the aye-aye, a monkey having nocturnal habits. In the *Ungulata* the hoofs need no delicacy of touch as regards the discrimination of minute points. Such animals, however, have broad, massive sensations of touch, enabling them to appreciate the firmness of the soil on which they tread, and under the hoof we find highly vascular and sensitive lamellæ or papillae, contributing no doubt, not only to the growth of the hoof, but also to its sensitiveness. The *Cetacea* have numerous papillae in the skin, regarding which John Hunter remarks : “ These villi are soft and pliable ; they float in water ; and each is longer or shorter according to the size of the animal. In the spermaceti whale they are about a quarter of an inch long; in the grampus, bottlenose, much shorter; in all they are extremely vascular; they are sheathed in corresponding hollows of the epiderm.” In some whales the skin is thrown into numerous longitudinal plaits on the under and fore part of the body *(Balænoptera).* Prof. Owen remarks regarding these: “ It is peculiar to the swifter swimming whales that pursue mackerel and herring, and may serve to warn them of shoals, by appreciation of an impulse of the water rebound­ing therefrom, and so conveying a sense of the propinquity of sunken rocks or sand-banks. Sensitiveness to the movements of the ambient ocean is indicated by certain observed phenomena. The whale-fishers aver that when a straggler is attacked its fellows will bear down from some miles’ distance, as if to its assistance; and it may be that they are attracted by perception of the vibration of the water caused by the struggles of the harpooned whale or cachalot” (Owen’s *Comparative Anatomy,* vol. iii. p. 189). Bats have the sense of touch strongly developed in the wings and external ears, and in some species in the flaps of skin found near the nose. These “nose-leaves” and expanded ears frequently show vibratile movements, like the antennae of insects, enabling the animal to detect slight atmospheric impulses. In the vampires *(Desmodi)* and fruit-eating bats *(Pteropi)* the auricular and nasal appendages are small; ‘ ‘ such sensitive tactile guides or warners in flight are only needed in the bats of active food, which must follow in swift evolutions, like the swallows, but in gloom, the volatile insects that people the summer air at dawn or dusk ” (Owen). There is little doubt that many special forms of tactile organs will be found in animals using the nose or feet for burrowing. A peculiar end­organ has been found in the nose of the mole, while there are “end­capsules ” in the tongue of the elephant and ‘ ‘ nerve rings ” in the ears of the mouse.

*End-Organs of Touch in Man.—*In man three special forms of tactile end-organs have been described, and can be readily demonstrated.

(1) *The End-Bulbs of Krause.—*These are oval or rounded bodies, from 1/360 to 1/170 of an inch long. Each consists of a delicate capsule, composed of nucleated con­nective tissue enclosing numerous minute cells. On tracing the nerve fibre, it is found that the nerve sheath is con­tinuous with the capsule, whilst the axis cylinder of the nerve divides into branches which lose themselves among the cells. Waldeyer and Longworth state that the nerve fibrils terminate in the cells, thus making these bodies similar to the cells described by Merkel *(ut supra).* See fig. 5. These bodies are found in the deeper layers of the con­junctiva, margins of the lips, nasal mu­cous membrane, epi­glottis, fungiform and circumvallate papillae of the tongue, glans penis and clitoris, mucous membrane of the rectum of man, and they have also been found on the under surface of the “ toes of the guinea-pig, ear and body of the mouse, and in the wing of the bat ” (Landois and Stirling). In the genital organs aggregations of end-bulbs occur, known as the “genital corpuscles of Krause” (fig. 4). In the synovial mem­brane of the joints of the fingers there are larger end-bulbs, each connected with three or four nerve-filaments.

(2) *The Touch Corpuscles of Wagner and Meissner.—*These are oval bodies, about of an inch long by of an inch in breadth. Each consists of a series of layers of connective tissue arranged transversely, and containing in the centre granular matter with nuclei (fig. 7). One, two, or three nerve fibres pass to the lower end of the corpuscle, wind transversely around it, lose the