vertically on the sensory surface, but in the opposite direction, as when a hair on a sensory surface is pulled or twisted. Touch is therefore the sense by which mechanical force is appreciated, and it presents a strong resemblance to hearing, in which the sensation is excited by intermittent pressures on the auditory organ. In addition to feelings of contact or pressure referred to the sensory surface, contact may give rise to a sensation of temperature, according as the thing touched feels hot or cold. These sensations of contact, pressure or temperature are usually referred to the skin or integument covering the body, but they are experienced to a greater or less extent when any serous or mucous surface is touched. The skin being the chief sensory surface of touch, it is there ∙that the sense is most highly developed both as to delicacy in detecting minute pressures and as to the character of the surface touched. Tactile impressions, properly so called, are absent from internal mucous surfaces, as has been proved in men having gastric, intestinal and urinary fistulae. In these cases, touching the mucous surface caused pain, and not a true sensation of touch.

In the article Nerve (*Spinal)* the cutaneous distribution of the organs of touch is dealt with.

The Amphibia and Reptilia do not show any special organs of touch. The lips of tadpoles have tactile papillae. 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 urogαllus),* “ enabling it to grasp with more security the frosted branches of the Nor- wegian pine trees ” (Owen). 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 de- tection 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 F. S. Merkel, or the corpuscles of Grandry (fig. 1). 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 more flattened nucleated 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 lamellae. 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 sensitive- ness, 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 *(A teles).* Such papillae also abound in the naked skin of the nose or snout, as in the shrew, mole, pig, tapir and elephant. In the *Ornithorhynchus* 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 way analogous 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 lamellae or papillae, contributing no doubt, not only to the growth of the hoof, but also to its sensitiveness. The Cetacea have numerous sensory papillae in the skin. 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. 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 end-organ has been found in the nose of the mole, while there are “ end-capsules ” 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.

I. *The End-Bulbs of Krouse,—*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. W.. Waldeyer and Longworth state that the nerve fibrils terminate in the cells, thus making these bodies similar to the cells described by F. S. Merkel *{ut supra).* (See fig. 4.) 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. 3). In the synovial membrane of the joints of the fingers there are larger end-bulbs, each connected with three four nerve-filaments.

(2) *The Touch Corpuscles of Wagner and Meissner.—*These are oval bodies, about 1/300 of an inch long by -1/500 of an inch in breadth. Each consists of a scries of layers of connective tissue arranged transversely, and containing in the centre granular matter with nuclei (figs. 2, 3 and 6). One, two or three nerve fibres pass to the lower end of the corpuscle, wind transversely around it, lose the white substance of Schwann, penetrate into the corpuscle, where the axis cylinders, dividing, end in some way unknown. The corpuscles do not contain any soft core, but are apparently built up of irregular septae of connective tissue, in the meshes of which the nerve fibrils end in expansions similar to Merkel’s cells. Thin describes simple and compound corpuscles according to the number of nerve fibres entering them. These bodies are found abundantly