forms invisible until sought, being obscured by the frontal feathers or the backward prolongation of the horny sheath of the beak. The wings are somewhat feeble, and the legs have the toes placed in pairs, two before and two behind. The tail is capable of free vertical motion, and controlled by strong muscles, so that, at least in the true Toucans, when the bird is preparing to sleep, it is re­verted and lies almost flat on the back, on which also the huge bill reposes, pointing in the opposite direction.

As may be inferred from the foregoing, the Toucans are a Neotropical form, and by far the greater number inhabit the northern part of South America, especially Guiana and the valley of the Amazons. Some three species occur in Mexico, and several in Central America. One, *R. vitell- inus,* which has its headquarters on the mainland, is said to be common in Trinidad, but none are found in the Antilles proper. The precise place of the Family in the heterogeneous group *Picariæ* cannot yet be determined. Its nearest allies perhaps exist among the *Capitonidæ*; but none of them are believed to have the long feather-like tongue which is so characteristic of the Toucans, and is, so far as known, possessed besides only by the *Momotidæ (cf.* Motmot, vol. xvii. p. 3). But of these last there is no reason to deem the Toucans close relatives, and, according to Swainson *(ut supra,* p. 141), who had opportunities of observing both, the alleged resemblance in their habits has no existence. Those of the Toucans in confinement have been well described by Broderip and Vigors *(Zool. Journal,* i. p. 484; ii. p. 478), and indeed may be partially observed in many zoological gardens. Though feeding mainly on fruits, little seems amiss to them, and they swallow grubs, reptiles, and small birds with avidity. They are said to nest in hollow trees, and to lay white eggs. (a. n.)

TOUCH may be defined as a sense of pressure, referred usually to the surface of the body. It is often understood as a sensation of contact as distinguished from pressure, but it is evident that, however gentle be the contact, a certain amount of pressure always exists between the sensitive surface and the body touched. Mere contact in such circumstances is gentle pressure ; a greater amount of force causes a feeling of resistance or of pressure referred to the skin; a still greater amount causes a feeling of muscular resistance, as when a weight is supported on the palm of the hand; whilst, finally, the pressure may be so great as to cause a feeling of pain. The force may not be exerted 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 fistulæ. In these cases, touching the mucous surface caused pain, and not a sensation of touch.

*Organs of Touch.—Comparative Sketch.—*The organs of touch present many varieties of form, from a simple filament of sensitive protoplasm to a highly complex end-organ connected with the commencement of a sensory nerve-fibre. The bodies of the lowest organisms are formed of contractile protoplasm, and mechanical con­tact with any resisting substances causes a change of form. Here is the simplest kind of touch—a response on the part of any portion of the surface of the body to a mechanical stimulus. The pseudopodia of the *Rhizopoda* are also organs of touch, and probably the cilia, the flagellæ, and the short rod-like bodies seen on many *Infusoria* belong to the same class of sensory organs. Among the *Cœlentera* (hydroid polyps, tubularians, *Hydromedusæ, Medusae, Anthozoa* or sea-anemones) tentacles are found, usually arranged in circles around the mouth or on portions of the body engaged in locomo­tion, as on the margins of the umbrella of *Medusae.* These have a large amount of sensibility, and serve as organs of touch. In some also there are stiff hairs on the tentacles and around the mouth, more differentiated tactile organs. The *Vermes* show organs of touch in the form of modified cells of the integument, connected with sensory nerves. These cells often assume the form of stiff rods projected from the surface (tactile setæ). Such are often found over the whole body of *Turbellaria* and *Nemertina,* on the tentacles of *Bryozoa,* on the head segment of *Lumbricidæ,* and on the tentacles and antennae of *Chætopoda.* In the latter group of animals tactile organs are also found in ring-like arrangements, called cirrhi, on the foot-stumps or parapodia. In some *Hirudinea* (leeches) compli­cated tactile rods are embedded in cup-shaped organs scattered over the body. Large prominences of the cuticle, called tactile papillae, are also found in many of the *Vermes* near the oral and genital orifices. The *Echinodermata* have also special parts devoted to touch, and these show their highest differentiation in the tentacles of the *Holothuroida. Arthropoda* show tactile organs in the form usually of rod-like bodies projecting from the surface of the appendages and chiefly connected with nerves passing to ganglionic cells. In *Crustacea* such organs are found on the antennae and other appendages, and on the antennae in *Myriapoda* and *Insecta.* In the latter they are also found on the tarsal joints of the feet. The ap­pearance of these rod-like bodies is seen in fig. 1.

Ciliated tentacular processes exist in the larva of *Brachiopoda* which are probably touch organs, but there are no definite organs of this kind in the adult form. The *Mol- lusca* have the sense of touch widely diffused. All the soft parts of the body are capable of feeling when touched, and in various situations there are fine hair-like prolongations from cells. These are supplied with nerves, and are touch organs. Such are found on the edge of the mantle in *Lamellibranchiata,* where they may be in rows; they also exist on the siphons, and “they serve to watch over the particles that get into the mantle cavity with the water ” (Gegenbaur). Processes of a tactile kind are also found on the epipodium, the edge of the mantle, and the cephalic tentacles in many *Gasteropoda,* and on the dorsal tufts of the *Nudibranchiata.* Here and there also there are enlargements of the integument covered with cilia and supplied by a nerve which have been regarded as touch organs, but are by some supposed to be connected with smell (see Smell). The *Tunicata* have cells with long filamentous processes in the integument, which are probably tactile in function.

In the great majority of fishes touch is limited to the lips, to parts of the fins, and to special organs called barbels. In the *Cyprinoids* there is a fold of skin bordering the mouth which is highly tactile. The lip of the sturgeon is covered with numerous papillae; the sucking lip of the lamprey is papillose and highly sensitive. The fins are in many fishes modified to serve as organs of touch. Thus the gurnards *(Triglidæ)* have three soft flexible rays detached from the fin, and “the filiform radial appendages of the *Polynemidæ,* the prolonged ventral fins of *Osphromenus, Tricho- gaster,* and other Labyrinthibranchs, and of the *Ophidiidæ,"* are examples of this class of organs (Owen). The barbels are long slender processes of skin, either single or in pairs, found in the *Siluridæ,* loaches, barbels, cods, sturgeons, and in the parasitic *Myxinidæ.* The nerves for the barbels come from the fifth pair of cranial nerves. “A cod, blind by absence or destruction of both eyeballs, has been captured in good condition, and it may be sup­posed to have found its food by exploring with the symphysial barbule, as well as by the sense of smell” (Owen). Bodies some­what similar to the Pacinian corpuscles (to be afterwards described) were discovered by Savi in 1844 in the torpedo; they are arranged in linear series on the anterior part of the mouth and nostrils, and over the fore part of the electrical organs. Each is composed of two capsules, one connected with the other, and containing a granular substance in which the nerve end is embedded. Peculiar mucous glands are also found outside the electrical organs of the torpedo which are believed to minister to touch. Similar organs exist in sharks, and John Hunter dissected the snout of the spotted dog-fish *(Scyllium)* “to show the manner of the nerves ramifying,