

The inner division of the ear, to which the nerve of hearing is connected, consists of an irregularly shaped body and three semicircular canals, two of them placed vertically but in different planes, the third set horizontally. Each canal of this membranous labyrinth has an enlargement near one end in the classes of vertebrates described above. From the frogs to the mammals, there is, adjoining the membranous labyrinth, a cavity known as the tympanum, which is connected with the throat by a tube, and in which in all these classes are small bones which serve to convey the vibrations producing sound.

"Any other system of organs could be used from similar comparisons, and would yield the same conclusions. Digestive systems in the bulk of the vertebrates consist of corresponding organs in the same order, with the appropriate glands pouring secretions into them at the same places. Excretory systems consist largely of the same mechanisms; muscles are arranged in much the same ways, are attached to corresponding bones, and serve mostly the same functions; blood vessels follow the same general courses, give off branches usually at the same points, and serve the same portions of the body. It might be argued that these systems, in order to perform their functions, must be arranged in these ways, and the fact that they are so much alike in the various vertebrates means only that they have certain things to do in relation to each other and are situated in the only places where these things can be done. This argument could not be applied, however, to the location of the endocrine glands. These organs produce secretions which, instead of being poured out through ducts, diffuse directly into the blood. In this liquid the secretions are carried everywhere, and there would be no necessity of having the glands located at any specific points. Yet the thyroid gland occurs always in the region of the throat near the front gill slits, from which place its secretion flows out to influence physiological processes in the remotest parts of the body. The pituitary, located always at the base of the brain, might be anywhere else and influence growth and the reproductive system equally well. The thymus develops always in the region of the gill slits, but in the adult extends, in the several classes of vertebrates, to various places in the neck region or upper part of the chest -- far from the seat of its principal known and supposed effects. The reproductive organs produce endocrine secretions which influence secondary sexual characters from head to foot (combs, wattles, tall feathers and spurs of fowls, for example). The conclusion that these organs might be elsewhere and still serve the same purpose is not mere conjecture. It has been proved by grafting them into strange situations, or by introducing their secretions artificially at other points.

"Internal Similarity with External Difference -- If experiments with the endocrine secretions show that a given function could be performed regardless of any particular anatomical arrangement, there are situations in which the tables are turned and many different functions are performed by essentially the same anatomical structure. A classical example of this relation, often described because it extends over a large number of well-known animals, is found in the fore and hind limbs of vertebrate animals. These limbs possess very similar skeletal foundations, but are externally modified in so many ways that they may be used for many different purposes. The human arm is rather simple and unspecialized, and its skeleton may be used as a starting point for comparisons. It is attached to the trunk through a shoulder girdle composed, on each side, of a collar bone and a