professional and business men, and overworked men in general, to something that will lighten their daily toils, give them a new lease of life, and open their hearts to a new world.

ERNEST R. ROOT.

(Balance next week.)

Read at the I B K A Convention.

## Alimentary Apparatus of the Bees.

If there be truth in the doctrine of organic inertia, and if modification of organs and d organisms has arisen wholly or in part through infringement upon their surroundings, then for the maximum of differentialism, we should look to organs and organisms most used, or those most important in the organic economy. Nutrition is the great function of animal life. To secure and prepare the food is the chief work, at least of all the lower forms of animal life We should expect then to find differention most marked in such organs as are useful in procuring the daily bread. Among insects, the legs, wings and alimentary organs are the real weapons in this important work of "bread winning." In bees, where the habits are so marvellously varied, we should expect a marvellous variation or modification in these organs, nor would we be disappointed. I think we would hardly except man himself, in the remark that nowhere in the whole animal kingdom, do we find more interesting and startling structural developments than are to be found in our study of the honey bee. Two years ago, at the New York meeting of this Association, I showed how vividly this is illustrated in the modification of the legs. The modified hairs, antennæ cleaner, wax jaws, pollen baskets, and pulvilli are marvels of structural modification, for the attainment of specific purposes. The functional complexity of the legs of these insects, is only equalled by their marvellous development and structural differentiation.

In this paper, I wish to explain the anatomy and physiology of the alimentary system of the bee. In the tongue, and digestive system of this insect, we find a structural modification even more surprising than that of the legs, equally, if not more marvelous than is to be found in any other organic structures.

In this respect I shall confine myself to a discussion of the tongue, the glands, the stomach, mouth, honey-stomach, and true stomach.

It is a curious fact that long and familiarly as the bee has been known, yet in all the descriptions no one has rightly understood the bees tongue. I know not a single description that is entirely accurate. Many of our latest writers are not as correct as was the grand old master Swommerdom. Even the last editor of the Encyclopedia, Brittannica, is wholly wrong. It says (Vol. III, p. 485), "it is not tubular, as Swommerdom had supposed, but solid throughout, and the minute depression at the extremity is not the aperture of any canal through which liquid can be absorbed. It performs strictly to the office of a tongue, and not a tube for suction." Every statement in this paragraph is entirely untrue: The bee's tongue is a double tube. The inner or central tube of the tongue is perforated at the end, and through this, nectar is drawn from tubular flowers. This tube is slitted too near the end, on the under side, and the edges of this rigid slit are united with the corresponding edges of the outer tube by a somewhat folded membrane. The length of the tongue varies from .23 to .26 of an inch. It is longer in the yellow than in the black races. At the base of this double cylinder just anterior to wnere the ligula joins the mentum, the central tube opens by a short slit on its upper side. By holding bees by the wings and permitting them to sip colored liquids, and then by cutting off their heads while still sipping, it is easy to learn just how to sip. When they have access to a large drop of nectar, they not only draw the liquid through the central tube, but also through a much larger extemporized tube formed by approximating their inoxillae. This is the way they suck their honey from such bountiful sources as the linden, where a single colony of bees may store fifteen pounds in a day. In case the nectar is at the bottom of long corolla tubes, then the bee can only use the small central tube and must sip very slowly. Again in case the nectar is spread out thin on any surface, the bee can throw the central tube out by tightening the folded membrane, and by parting the slit can draw in and lop up the spread out liquid. This is also a slow process. The outer tube is imperforated at the end, and by filling this with blood the tongue is speedily elongated. Thus the tongue is extended by the action of muscles, aided by this protrusive force of the nutritive fluid which is also forced into the tongue by muscular action.

Connected with the digestive apparatus, are three pairs of glands. The upper head glands are high up in the head cavity, and in structure resemble a compound leaf, or the melbomian glands in our own eye lids. That is, a central tube receives the ducts from numerous follicles. The main ducats empty one on each side at the base of the mouth. Below the glands just mentioned are the lower head glands. These are compound racemose glands, and empty into a long duct, which also receives the ducts from a second pair of similar glands located in the throax. The common duct from these four glands empties just at the position of the slit at the base of the ligula, just where any