in the canal. In fact, however, the female at the time of oviposition lives in the lower part of the rectum and even attains the vicinity of the anus, although the earlier portion of the adult life history is passed in the small intestine, where the worms acquire sexual maturity and copulate. Evacuated from the body, the embryo undergoes transformation to the second embryonic stage while still within the egg shell, and now awaits ingestion by a new host. The primary infection is by drinking-water or contaminated fruit or vegetables, which are eaten uncooked; but self-infection and transference to other individuals are brought about by scratching and rubbing with the fingers to allay the intense itching caused by the daily migration of the females out from the anus on to the perineum and the surrounding parts. Perhaps in the distribution of *Oxyuris* eggs the flies play a part such as Grassi has demonstrated for *Trichocephalus* and eggs of *Tænia*. The direct development is very rapid, as Leuckart obtained experimentally *Oxyurides* 6–7 mm. long within fourteen days after ingestion of the eggs; Grassi and others have confirmed this by further experiments.

Pathology.—The females are far more numerous than the males, and by their migrations determine unbearable pruritus, which recurs periodically on retiring. In a number of cases among young girls the worms have migrated into the vagina and have produced onanism, and even the inception of nymphomania. In many cases large numbers in the rectum have excited no untoward symptoms, but in others they have produced reflex nervous activities of all grades up to epileptic attacks, such as have been noted under *Ascaris*. Recent investigations in Egypt have demonstrated the responsibility of this parasite for nodules on the rectal wall, previously attributed to *Schistosoma*, which contain eggs of *Oxyuris vermicularis* in a calculus. *Oxyuris* has also been recorded in tuberculous nodules in the cavum Douglasii of a female, and Vuillemin has recently discovered them in a tumor near the anus of a boy. The latter case shows definitely the wandering of the worms through 2 cm. or more of solid tissue. This habit exhibits a new and evidently dangerous feature in the parasitism of this species through the disturbance of the tissues and the introduction into them of bacteria from the rectum.

Treatment.—It is difficult to remove these worms entirely. Vermifuges and purgatives with enemata, etc., are successful to a degree; but the ease of auto-infection is an obstacle to a complete cure. Local application of mercurial ointment will alleviate the pruritus, and manual extraction, if prolonged, will reduce their numbers rapidly. But in any event treatment is prolonged.

The sub-class of the Gordiacea includes forms familiarly known as "hair snakes" or "hair worms." They are greatly elongated, slender worms, somewhat filaria-like in external appearance, but of radically different internal structure. Lateral fields are wanting, and the body musculation is of a different histological type from that of the Eunematoda. The mouth is occluded and the alimentary canal persists in the adult only as a functionless vestigial strand. In both sexes the reproductive organs open to the exterior with the alimentary canal at a terminal or subterminal cloaca. The reproductive system is constructed on a different plan, and the lateral canal system is wanting. The male has no spicules, but the posterior end of the body is forked and functions as grasping organ.

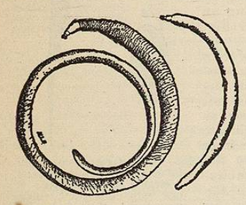

FIG. 3570. — *Gigantorhynchus gigas*. Male at right, female at left. Half natural size. (Original.)

The adult lives free in ponds, swamps, and other bodies of water, and the eggs are deposited on the stems of water plants. The larvæ possess a proboscis armed with hooks and bore into the body cavity of aquicolous insect larvæ, or rarely mollusks, where they encyst. According to Villot the second stage is passed in the intestine and body cavity of fishes. More commonly apparently the worms develop to maturity in the body cavity of insects, from which they emerge into the water for the adult free existence.

Several species have been reported from the human alimentary canal. They are pseudoparasites, having been swallowed, according to one view, in the adult condition with drinking-water; but their occurrence in fruit, especially apples, makes this even a more likely source of infection. Lockwood noted in 1876 the frequent presence, in fruit, of *Mermis*, another genus of Eunematoda, and suggested the probable occurrence of this form as a pseudoparasite of man under conditions; this has not been actually recorded so far as I find. But of Gordius as a pseudoparasite Parona has recently listed eleven cases, the first as early as 1638; of these Kirtland's (Ohio) is the only one from the United States. Two other unpublished cases have recently been communicated to me from Michigan and Maryland. It will be of no particular value to enter here upon a detailed description of the species found.

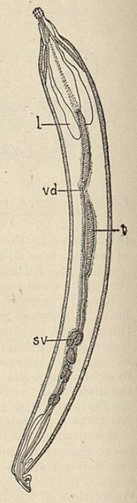

FIG. 3571.—*Gigantorhynchus gigas* Opened to Show Internal Anatomy, *l*, Lemniscus; *sv*, seminal vesicle; *t*, testis; *vd*, vas deferens. Modified. (Original.)

The Gordiacea are, however, emphasized by Cobbold as important for the medical practitioner, since they have been passed off as the guinea-worm and as having been evacuated with fecal matter by neurasthenic persons under treatment.

The Acanthocephala may best be discussed as an appendix to the class Nematoda, although they are regarded by many as a cognate class and by others are separated even more widely. The forms included here, though parasites of the most complete type, are not common in man. The group may be characterized as follows: Elongated, cylindrical body, often deeply corrugated, bearing at anterior end a retractile proboscis provided with many minute hooks in rows. No trace of alimentary canal. Reproductive organs open at posterior end; sexes separate. Male with campanulate bursa about the orifice. Mostly small forms, parasitic as adults in vertebrates only. The structure is uniform, and can be learned from the brief account which follows of the largest and commonest species.

Gigantorhynchus gigas Hamann 1892.—(Syn.: *Tænia hirudinacea* Pallas 1781; *Echinorhynchus gigas* Goeze 1782.)

Body milk white, sometimes slightly tinted, with transverse irregular ridges. Posterior end somewhat smaller; proboscis spherical, armed with five or six rows of hooks. The proboscis can be retracted into a neck-like region, which is much slimmer than the following portion of the body. Male, 60–90 mm. long by 3–5 mm. broad, with bell-shaped caudal pouch. Female, 230–350 mm. long by 4–9 mm. broad; tail blunt; eggs almost cylindrical, 0.087–0.1 mm. long with three embryonic envelopes.

The adult worm is found in the small intestine of the pig, ordinarily fixed to the wall by the proboscis, and is widely distributed.

Structure.—The elongated body (Fig. 3570) is largest near the head and tapers gradually toward the posterior end. At the anterior end a sharp constriction separates

the body from the short neck portion, which is not more than one-fourth or one-fifth the diameter of the body close to it. From the apex of this region may be projected the proboscis which is contained within it, like the reversed finger of a glove. As the proboscis rolls out the hooks also turn outward, and when the proboscis is completely extruded the shape of the organ is nearly that of a sphere on which are from five to six irregular rows of hooks. Behind these the proboscis is slightly smaller.

If the internal structure be examined, it will be seen that the proboscis is provided with retractor muscles, by means of which it may be withdrawn into the body. At the base of the proboscis is the small mass of nervous matter which represents the brain.

There is no trace of an alimentary canal, hence these forms, like the tapeworm, take nourishment by absorption. Two elongated sac-like organs hang down into the body cavity along the sides of the proboscis. These are the lemnisci (*l*, Fig. 3571); their function is uncertain.

The mass of the body is made up of the organs of the reproductive system. All these worms are dicœcious. The male organs (Fig. 3571) consist of two large testes, together with the ducts and accessory glands connected with them. The tail of the male has a hemispherical expansion, something like the caudal bursa of other Nematoda; the male sexual opening in the centre of this sac at the tip of the body is provided with a small copulatory organ. The internal sexual organs of the female are much similar in general appearance; the ovaries lie toward the front of the body cavity, which is largely filled with eggs in various stages of development. These are discharged by the oviduct, which opens at the posterior end of the body.

Life History.—The eggs of *Gigantorynchus* are discharged from the alimentary canal of the host and distributed with fæces. When eaten by some insect they are hatched in its intestine. The embryo, which has a conical form armed at one end with four hooks like tapeworm hooks, and a number of smaller ones, penetrates into the abdominal cavity of the insect and encysts there. In this condition the embryos may even live through the metamorphoses of the insect until the host is eaten by some pig. In the alimentary canal of the pig the embryo is set free, attaches itself and acquires maturity. There is some dispute as to what insect is the intermediate host; the white worm-like larva of the May bug and the larva of the common rose chafer have been found to contain these worms in Europe, and Stiles has experimentally infected the larvæ of the June bug in this country. It is also maintained that various species of snail may function as the larval host. In all probability the larva is not confined to a single host, but may develop in many.

Leuckart accepts some reports of the occurrence of this species in man as trustworthy, and Lindemann says that it is not rare as a human parasite in Southern Russia. Schneider notes the consumption, as food, of the larvæ and adults of *Melalontha*, the May beetle, which acts as the intermediate host, so that infection is evidently possible.

Gigantorhynchus moniliformis (Bremser 1819).—Body attenuated anteriorly. Proboscis, 0.425–0.450 mm. long, 0.175–0.19 mm. broad, with hooks in fifteen transverse and twelve longitudinal rows. Male, 4–4.5 cm. long. Female, 7–8 cm. long, or even up to 27 cm., according to Westrumb. Eggs ellipsoidal, 85 μ long, 45 μ broad.

The normal hosts of this species are field mice, rats, etc., and the intermediate host in Italy has been determined as *Blaps mucronata*. Calandruccio in experimenting on the life history succeeded in infecting himself with the adult. The severe symptoms which manifested themselves were dispelled by the evacuation of the worms. In other cases of the occurrence of this species as a human parasite its identity was less definitely established.

Echinorhynchus hominis Lambl 1859. — Length, 5.6 mm.; width, 0.6 mm.; proboscis almost spherical with twelve transverse rows of eight hooks each. Large hooks, 103 μ long, small hooks, 77 μ.

An uncertain species of which Lambl found a single specimen at Prague in the small intestine of a boy who had died of leukæmia.

Echinorhynchus sp. Welch 1872.—In 1872 Welch described as *Echinorhynchus* a body which he found encysted in the mucosa of the jejunum of a soldier. According to Railliet it was evidently a Linguatulid (see *Arachnida*).

Echinorhynchus sp. Moniez 1896.—Kunstler and Pitres found certain peculiar bodies in the pleural cavity of a patient who had suffered two years from pleurisy, but without fever. They interpreted these structures as coccidia, but Moniez holds with greater probability to their likeness to eggs of *Echinorhynchus*. The case is entirely isolated under either explanation.

Henry B. Ward.

PRINCIPAL ARTICLES CONSULTED.

Bancroft, T. L.: Metamorphosis of *Filaria Bancrofti*. Proc. R. Soc. N. S. Wales, xxxiii., 48.
Blanchard, R.: Nouveau cas de *Filaria loa*. Arch. Parasitol., ii., 504.
Braun, M.: Die thierischen Parasiten des Menschen, Würzburg, 1902.
Graham, J. Y.: Naturgeschichte der *Trichina spiralis*. Arch. mikr. Anat., l., 219.
Huber, J. C.: Bibliographie der klin. Helminthologie, Jena, 1893–98.
Leuckart, R.: Die Parasiten des Menschen, vol. ii., Leipzig, 1876.
Linstow, O. von: Arten der Blutfilarien des Menschen. Zool. Anz., xviii., 76.
Looss, A.: *Strongylus subtilis*, n. sp., Centralb. f. Bakt. und Par., xviii., 161; Lebensgeschichte des *Ankylostoma duodenale*, ibid., xxi.
Lothrop and Pratt, J. H.: Two Cases of Filariasis. Am. Jour. Med. Sci., cxx., 525.
Manson, P.: Tropical Diseases, London, 1898.
Moniez, R.: Traité de Parasitologie, Paris, 1896.
Nuttall, G. H. F.: On the Rôle of Insects, Arachnids and Myriapods as Carriers in the Spread of Bacterial and Parasitic Diseases of Man and Animals. Johns Hopkins Hospital Reports, viii., 1.
Parona, C.: Pseudo-parassitismo di Gordio nell'uomo. Clinica Med., 1901, No. 10.
Railliet, A.: Traité de Zoologie médicale et agricole, second edition, Paris, 1893–95.
Thayer, W. S.: Occurrence of *Strongyloides intestinalis* in the United States. Jour. Exp. Med., vi., 75.
Stiles, C. W.: Trichinosis in Germany, Bull. 30, Bureau Animal Industry, 1901; Significance of Recent American Cases of Uncinariasis in Man. Eighteenth Annual Report, Bureau Animal Industry, United States Dept. Agr., 1902.
Ward, H. B.: Parasitic Worms of Man and the Domestic Animals. Nebr. Agl. Rept., 1895.
Williams, H. F.: Frequency of Trichinosis in the United States. Jour. Med. Research, vi. 64, 1901.
Also numerous shorter papers by the same authors, Askanazy, Cobbold, Grassi, Hassall, Kiichenmeister, Leichtenstern, Leidy, Ludwig, Magalhaes, Mark, Stossich, Strong, and others.

NEOPLASMS. See *Tumors*.

NEPHRECTOMY; NEPHROTOMY. See *Kidneys, etc.*

NERVES, GENERAL PHYSIOLOGY OF.—HISTOLOGICAL AND GENERAL.—Nerves consist essentially of the long, slender processes of nerve cells. They are hence composed of protoplasm, and they possess the general chemical and physical properties of this substance; but they differ physiologically from other forms of protoplasm, in that they possess to a high degree the properties of conductivity and excitability, while the properties of growth, metabolism, respiration, and contractility are feebly developed or altogether absent. There is in these respects a marked physiological difference even between the nerve and the cell body from which it arises. Many of the reactions of the cells to external conditions are the opposite to the reactions of the nerve. The cell generates nerve impulses; it possesses spontaneity or automatism, absent in the fibre; it is closely dependent on a supply of oxygen, while the nerve is almost independent; it has an active metabolism, which the nerve lacks almost entirely; it respires, while the nerve respires little or not at all; it or some of its dendritic processes may be contractile, the nerve has lost this property altogether. The physiology of the nervous tissue, which includes nerve cells, differs therefore in many respects from that of the nerves proper, which we shall consider here. In short, the nerve cells possess pre-eminently the property of automatism or spontaneity; the nerve fibre, the property of conduction.