

und II, sowie in der Summe der beiden Serien erhielt man ein wenig mehr M und ebensoviel W gr als W glb: I. 16 M, 6 W gr, 6 W glb (12 W). II. 41 M, 19 W gr, 18 W glb (37 W). I + II. 59 M, 26 W gr, 26 W glb (52 W).

Die männlichen Nachkommen der *Valesina*-Weibchen waren in Farbe und Zeichnung sehr konstant und zeigten kaum Abweichungen, dagegen kamen solche bei den beiden weiblichen Formen vor. So sind Exemplare von *Valesina* vorhanden, die sehr aufgehellt sind.

Nachschrift. Herr Professor Spormann in Stralsund, dem ich die *Valesina*, welche zu meinem obigen Versuch dienten, verdanke, hat die Freundlichkeit gehabt, mir auf meine Bitte seine sich auf einen Zeitraum von 12 Jahren erstreckenden Beobachtungen über das Vorkommen von *Valesina* in Pommern nachträglich mitzuteilen. Danach ist die *Valesina* dort häufiger geworden und kommt stellenweise, so bei Stralsund, den typischen Weibchen an Zahl gleich. Sie scheint sich in der näheren Umgebung von Stralsund zu einer festen Rasse auszubilden. Bezüglich ihres Vorkommens am Meere ist sie in den von der Küste entfernteren Waldungen häufiger, auf Rügen ist sie seltener oder fehlt ganz. Die Männchen von *A. paphia* erscheinen zuerst, nach 8—14 Tagen zeigen sich die typischen Weibchen mit vereinzelt *Valesina*, bis diese immer mehr an Zahl zunehmen.

Sodann erfuhr ich von Herrn Präparator Ude in Berlin, daß sein Vater im Jahre 1910 bei Tegel etwa 100 Exemplare von *A. paphia* gefangen hat, darunter ungefähr 20 *Valesina*. Diese Zahlen würden in meinem obigen Versuch mitgeteilten entsprechen. Denn dort erhielt ich unter 111 Exemplaren 26 *Valesina*, was einem Verhältnis von 100 zu 23,4 gleichkommt.

4. The Genus *Neorhynchus* in North America¹.

By Dr. H. J. Van Cleave.

(With 5 figures.)

eingeg. 4. September 1913.

For four years the writer has carried on, under the direction of Professor Henry B. Ward, a study of the Acanthocephala of fresh water fishes and turtles of North America. During that time there have come under his observation four new and one little known species of the genus *Neorhynchus*. These are the first species described for that genus since its founding by Hamann in 1892 to include the two species *Echinorhynchus rutili* O. F. Müller and *Echinorhynchus agilis* Rudolphi.

¹ Contributions from the Zoological Laboratory of the University of Illinois, under the direction of Henry B. Ward, No. 24.

Within the genus *Neorhynchus* the writer has found the number of nuclei in any given organ or region of the body is fixed for each species. The results of a detailed study of cell-constancy in members of this genus will appear soon. Certain points in this matter of constancy of numbers of nuclei hold for every member of the genus. This last fact has led me to propose an emendation of the characters diagnostic for the genus *Neorhynchus*, which are, as I conceive them;

- 1) the subcuticula contains six giant nuclei arranged, normally, five in the mid-dorsal line of the body and one in the mid-ventral line;
- 2) one lemniscus contains two giant nuclei, the other a single one;
- 3) the wall of the proboscis receptacle contains but a single layer of muscle.

In the *Neorhynchi* clearly marked specific characters such as might serve for a ready determination of species are extremely few. Body size is such an unstable quantity that very little taxonomic value may be given it. The most sharply defined diagnostic points of value are: the number, shape, and size of the hooks upon the proboscis; and the shape and size of the embryos within the body of the mature female. The difficulties encountered in interpreting descriptions giving the length of hooks without specifying how the measurements were taken, have led the writer to insert here the statement that in all his measurements the length of the hook is taken to be the longest straight line from the tip of the hook to the union of the hook with its basal portion or root (figs. 1 and 3 *a—b*).

Neorhynchus gracilisentis n. sp.

Body small, subcylindrical, slightly tapering at either end, bent into a slight crescent. Fully mature females 1,7—4,0 mm. long, greatest breadth slightly anterior of middle, 0,38 mm. Males 1,5—3,0 mm. long, greatest breadth about 0,30 mm. Proboscis short, slightly longer than wide when fully extended, largest at tip, tapering toward base to region of basal row of hooks where abrupt change in diameter occurs; armed with three circles of twelve hooks each. Hooks all delicate, terminal row curved, 0,015—0,017 mm. long, root long, — 0,020 mm.; second row curved but less than first, 0,012—0,015 mm. long, root long; third or basal row slightly curved, 0,015—0,020 mm. long, without pronounced root. Embryos conspicuously spindle-shaped, 0,036—0,040 mm. long by 0,010 mm. broad.

In general the females are larger than the males for although in this species the upper and lower limits of size are very nearly uniform for the two sexes yet greater numbers of individuals among the females are found near the upper limit, while among the males there is a ten-

dency for more to approach the lower limit. In these measurements only fully mature individuals were considered. The living animals are so translucent that the smaller individuals can be distinguished by the unaided eye only with difficulty. The larger individuals have a very light milky appearance while in one or two instances a slight orange tint was seen. After fixation and preservation in alcohol the color is a uniform translucent white.

The hooks of this species (fig. 1) differ radically in shape from those of the other members of the genus. The portion of the hook protruding beyond the wall of the proboscis is very much smaller than the portion connected with the root. The shape of the root is also characteristic of no other species that has been observed by the writer.

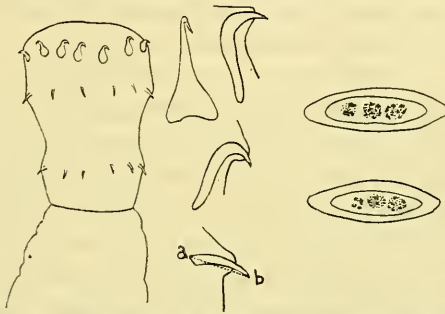


Figure 1. *Neorhynchus gracilientis* n. sp. Proboscis ($\times 145$), hooks ($\times 465$), embryos ($\times 465$). Camera lucida drawing.

Instead of assuming the disc shape with the hook proper protruding from its anterior end this form has a much elongated and narrowed anterior portion which goes over gradually into the curved hook portion. Such is the condition found in the terminal and middle hooks, while the basal row contains slightly curved hooks with no roots (fig. 1).

The cuticula is an extremely thin, non-cellular layer which covers the entire body. It has a fairly uniform thickness of about 0,001 mm. The subcuticula comprises the greatest part of the body-wall. In thickness this layer ranges from 0,017—0,030 mm. There is not the evident arrangement of this layer into a fibrous and a granular region as Kaiser (1893, pl. 2, fig. 10) has so clearly figured for *Echinorhynchus angustatus*. Within the subcuticula are found two types of canals. The dorsal and the ventral longitudinal canals extend from the base of the proboscis posteriad to the end of the body. These two canals are in direct communication with each other through a system of regularly arranged circular canals which are much smaller than the longitudinal trunks and differ from them in that they frequently branch and may occasionally anastomose. The body musculature is not very strongly developed.

This layer is a syncytium containing regions of longitudinal and of circular fibres but the individual fibres of this layer do not represent cells. This syncytium is supplied with two rows of nuclei which extend the length of the body. These nuclei are paired so that a cross section through the body might show a nucleus in the muscle layer on either side of the dorsal longitudinal canal. These are so regular in arrangement that in no case could more than two muscle nuclei occur in a single cross section of the body.

The lemnisci are short, never extending much beyond the end of the proboscis receptacle when the proboscis is protruded. Their average length is about 0,5 mm. These are not bilaterally paired organs but arise as two sacs in the anterior end of the body, one dorsal and the other ventral in position. The dorsal lemniscus bears two nuclei while the ventral possesses but a single one.

The proboscis receptacle is a sac consisting of a single muscular layer extending from the base of the proboscis into the body cavity for a distance of 0,4—0,6 mm. From the rounded base there extend posteriad two long retractors of the receptacle which find attachment one on the dorsal wall and the other on the ventral wall of the body. These retractors of the receptacle are direct continuations of the pair of muscles within the proboscis called the invertors of the proboscis. Within the proboscis receptacle is located the brain which is triangular in lateral aspect with the base of the triangle attached to the ventral wall of the receptacle near the posterior end of the latter. The brain has a length ranging from 0,085—0,100 mm., with a maximum breadth of 0,035—0,040 mm.

The testes, two in number, are slightly elongated oval bodies lying one anterior to the other in the midst of the body cavity of the male. The anterior testis has an average length of over 0,30 mm. and a breadth of about 0,17 mm., while the posterior testis is considerably shorter, being only 0,24 mm. long, but having a breadth equal to that of the anterior testis. The cement gland is a compact mass just posteriad to the posterior testis. The posterior margin of this gland is hollowed out to receive the reservoir of the cement gland. The average length of the cement gland is 0,238 mm, with a range of variation from 0,170—0,400 mm. in different individuals. It has a dorso-ventral depth varying from 0,150—0,260 mm., with an average of 0,200 mm. The eight large nuclei with their approximately uniform distribution throughout the gland, are typical for this species. Cement reservoir is the name given to the spherical body filling the posterior emargination of the cement gland. It has a diameter of 0,108 mm. A very short tube connects this reservoir with its gland. This duct proceeds from the poste-

rior ventral margin of the gland. The two ducts which convey the secretion of the cement gland posteriad from the reservoir empty into the vas efferens in a region just anterior to the cirrus.

Immature females taken in the month of October at Havana, Illinois, were in a stage of development just preceding the destruction of the ovary to form the egg-masses (Eiballen). These specimens which were about 1,5 mm. long contained in the body cavity a single oval body for the ovary instead of a paired organ as so frequently described for other *Acanthocephala*. The ovaries in these immature forms were 0,054 mm. long and 0,032 mm. wide. The egg-masses which result from the breaking up of the ovary vary considerably in size. They may be as large as $0,080 \times 0,042$ mm., while some are much smaller, $0,040 \times 0,022$ mm. On the contrary considerable stability is found in the dimensions of the spindle shaped embryos (fig. 1) which are fairly constantly $0,036 \times 0,010$ mm.

There are three regions of the female genital tract. The anterior-most of these, which is held in place by the suspensory ligament running the length of the body cavity, is the selective apparatus. This extends backward into the uterus which is followed directly by a more heavily walled vagina. The vagina communicates with the exterior through an opening slightly anterior to the posterior end of the body and on the ventral surface. In the region of the vaginal sphincter the vagina has a diameter of about 0,027 mm.

This parasite occurs in the intestine and intestinal caeca of the gizzard-shad or hickory-shad, *Dorosoma cepedianum* (Le Sueur), taken from the Illinois River at Havana, Illinois, and at Peoria, Illinois. The period of infestation is confined to the fall, winter, and spring. The result of an examination of more than two hundred specimens of the host, extending through a period of over three years, has revealed a heavy infestation beginning in October when many of the Neorhynchi are small and immature, and continuing through the winter to April or May when the numbers decrease. Finally, beginning in May or June there is a period of freedom from these parasites. This immune period which continues through the rest of the summer must find explanation either in the nature of the food of the shad during that time or in the life-history of the parasite. During the period of infestation practically every specimen examined harbored some of the parasites, thus indicating that the intermediate host must be some common element of the food supply of the shad. The degree of infestation varied from a few individuals in some hosts to over a hundred parasites from a single shad.

Neorhynchus longirostris n. sp.

Body rather robust, posterior end slightly flexed ventrad. Proboscis making an angle with anterior end of body, inclined toward the ventral. Females average 6,2 mm. long, average maximum breadth 0,63 mm. Males average length 4 mm., average maximum breadth 0,47 mm. Proboscis cylindrical, average length 0,50 mm., average diameter

0,150 mm. Hooks rather irregularly arranged in about twenty circular rows of six to ten hooks each, largest hooks at tip, 0,054 mm., length in succeeding rows diminishing gradually to within a few rows of base of proboscis, then a distinct change in size of hooks occurs, basal hooks 0,016 mm. long. Embryos 0,027 mm. long by 0,008—0,010 mm. broad, oval.

The rather robust body of this species is distinctly different from the body form described for *N. gracilisentis*. Instead of tapering gradually toward either end, thus becoming spindle shaped in form, the body of this species maintains a fairly uniform diameter until within a very short distance from the posterior end and then narrows down to a rounded termination. A similar condition holds for the anterior end of the body. The uniform diameter is retained up to a short distance back of the base of the proboscis and then a gradual decrease in diameter brings the body width down to that of the proboscis. In the gravid



Figure 2. *N. longirostris* n. sp. Proboscis ($\times 145$), embryos ($\times 465$). Camera lucida drawing.

females the middle third of the body becomes somewhat distended by the accumulation of egg-masses and embryos.

From a mere cursory glance at specimens of this species one might be inclined to refuse them admission into the genus *Neorhynchus*. The reason for this lies in the unique form of the proboscis, and the number and arrangement of the hooks upon it. The short, bulbous proboscis

typical for all other Neorhynchi is here replaced by a strikingly long slender organ with numerous hooks arranged upon its surface. The proportion of the length of the proboscis to its width is approximately 10 : 3, as contrasted with the condition in other known species where the diameter and length of that organ are practically equal. However to the writer this disparity of proboscis form is of such a superficial nature that it becomes insignificant when considering the essential characters upon which the genus is based. Thus while the form of the proboscis seems to indicate the possibility of establishing a separate genus for this species the study of the other points in the morphology does not reveal a deviation of a degree higher than purely specific variations such as are ordinarily included within the same genus.

The cuticula has a uniform thickness of about 0,002 mm. The subcuticula is 0,03—0,05 mm. in thickness. Included within this last layer are found the circular canals communicating with the dorsal and the ventral longitudinal canals. Of these canals the circular ones have a diameter of 0,016—0,020 mm. There are present the two layers of muscles in the body-wall, the longitudinal and the circular layers, which together form a syncytium. The muscle sheath thus formed is supplied with two rows of nuclei which lie one row on either side of the median dorsal line of the body. The lemnisci are large, extending almost half the length of the body cavity. These sac-like organs have a maximum diameter 0,075—0,110 mm. near the anterior end of the body and gradually taper toward their distal ends. The proboscis receptacle has a length of 0,54 mm. when the proboscis is everted, and a maximum diameter of 0,11 mm. In case the proboscis is withdrawn into its receptacle the latter organ may become extended to a length of 0,87 mm. In the middle of the base of the receptacle, i. e. at its posterior end, is located the brain, a conical mass of cells whose length is 0,11 mm. and whose breadth is about 0,054 mm.

The size of the testes varies considerably but the anterior one is constantly as large as or larger than the posterior. The former has a range of $0,44 \times 0,14$ mm. to $0,60 \times 0,25$ mm., while the latter has a range of $0,275 \times 0,13$ mm. to $0,60 \times 0,25$ mm. in the materials examined. The cement gland is characterized by the possession of sixteen large nuclei. It is commonly a compact mass averaging about 0,27 mm. long by 0,25 mm. across with an indentation of the posterior margin into which is received the reservoir of this gland. Occasionally, however, the posterior end becomes narrowed so that the reservoir lies along the ventral side of the gland. The cement reservoir, which in shape approaches the spherical, has an average length of 0,15 mm. for the species. The cirrus is short and conical, included between the arched

portions of the copulatory bursa. Its length is about 0,045 mm. In side view the sperm reservoir is a triangular sac whose size varies radically under different conditions of sexual activity.

A single shad taken from the Illinois River at Havana, Illinois, July 4, 1910, gave three immature females each having a single ovary. In size these oval masses varied from $0,065 \times 0,038$ mm. to $0,110 \times 0,078$ mm. In a mature female containing both egg-masses and embryos several of the former were found to measure $0,110 \times 0,049$ mm., though they may vary enormously even within the same individual. The tract through which the developing embryos are discharged has a length of 0,490 mm. from the anterior end of the selective apparatus to the genital orifice. Of this tract 0,127 mm. is occupied by the vagina, which in the region of the vaginal sphincter has a diameter of 0,045 mm. The genital orifice already referred to lies on the ventral surface of the body near the posterior end.

Dorosoma cepedianum (Le Sueur) taken from the Illinois River at Havana, Illinois, occasionally carried this worm in its intestine. Mature forms have been taken during the months of June, July, November, and December, while a few individuals taken in July were still immature. Ordinarily this species was represented by a few scattering individuals occurring in the same host with the much more numerous *N. gracilisensis*. The periods of infestation of these two species of parasites in *Dorosoma* are not coincident. A comparison of the two forms reveals the fact that while no specimens of the more common species have ever been taken in the summer months, the species just described evidently reaches a maximum at that time. But a very small percent of the shad examined during the past three years have borne an infestation of *Neorhynchus longirostris*.

Neorhynchus emydis (Leidy).

Syn. *Echinorhynchus emydis* Leidy 1852. — *Echinorhynchus hamulatus* Leidy 1857.

This species originally described by Leidy in 1852 was later (1857) referred to by him under a new name, *E. hamulatus*. Through the efforts of Professor Ward the writer was permitted to study specimens of this species contained in the Leidy collections of the Academy of Natural Sciences of Philadelphia. The writer will here supplement the incomplete original description with facts gained from a study of the material from Leidy's collection and of large numbers of the same species in his own collection.

Body very much elongated, cylindrical. Females 10—32 mm. long, average maximum width 0,70 mm. Males about 8—11 mm. long by 0,70 mm. wide. Proboscis globular, length usually equals breadth,

average length 0,175 mm. Three circles of six hooks each. Terminal hooks strongly recurved, 0,095—0,103 mm. long, points reaching beyond bases of middle row. Middle row 0,049—0,059 mm. long, basal row 0,035—0,054 mm., average 0,043 mm. Embryos very small, oval, 0,016 \times 0,011 mm.

In size this species presents a more striking period of growth from the time the final host is reached until the individuals become fully mature than has been observed in any other species of the genus. Small individuals, 2 mm. and under in length, have been found with all the characters of the mature form except the body size and maturity of the sexual products. The color is commonly milky white although occasionally straw and orange tinted ones are found. The hooks of the

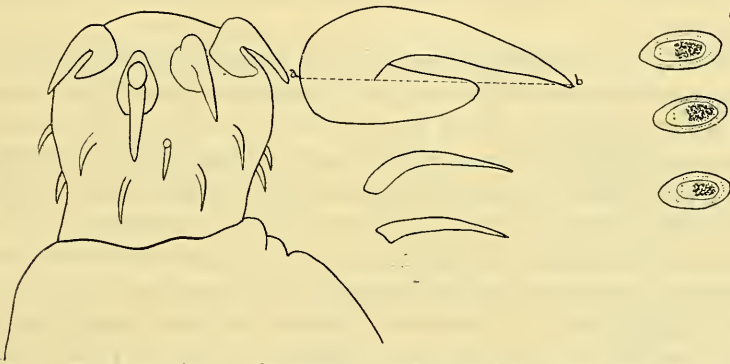


Figure 3. *N. emydis* (Leidy). Proboscis ($\times 145$), hooks ($\times 465$), embryos ($\times 465$). Camera lucida drawing.

second and basal rows differ from those of *N. cylindratus* and *N. tenellus* most sharply. In *N. emydis* these hooks are very much more slender and those of the basal row are but a trifle shorter than those of the second row, while for the other two species just mentioned (figs. 4 and 5) there is considerable difference in the length of the second and basal rows.

The cuticula is very thin. The subcuticula, which varies considerably in thickness, is usually about 0,140 mm. thick. In length the lemnisci are invariably over twice that of the proboscis receptacle. In fully mature females the extent of these organs is difficult to determine on account of the compact masses of eggs and embryos but the study of sections shows them to bear the same relation to the length of the proboscis receptacle as has been found in the males and immature females. The receptacle of the proboscis which has its posterior end obliquely truncated with the apex pointed dorsad, has a length of 0,5 mm.

The testes are very much elongated. Measurements of mature

males were as follows; anterior testis 0,87 mm. long by 0,26 mm. wide; posterior testis, 1,05 mm. long by 0,26 mm. wide. The cement gland while containing eight nuclei as just described for *N. gracilisentis* differs radically from the cement gland of the latter species in that it is an extremely elongated organ with the nuclei arranged in a row down its central axis. Immature specimens present an early stage in the development of this arrangement of the nuclei wherein the eight nuclei are arranged in two groups of four each.

Females taken at a time just preceding the formation of the egg-masses have an unpaired elongated ovary $0,350 \times 0,035$ mm. in the posterior third of the body-cavity. Mature females are filled with embryos that are very minute. The dimensions $0,016 \times 0,011$ mm. are quite uniform, varying but two or three microns in large numbers of measurements.

Leidy has recorded this species as parasitic in the intestine of »*Emys geographicus*, *Emys insculpta*, *Emys guttata*, and *Emys serrata*«. The writer has found it of frequent occurrence in the intestine of *Malacoclemmys geographicus* (Le S.) and of *Pseudemys elegans* Max. Nearly every turtle of the last two named species taken from the Illinois River and backwater lakes at Havana, Illinois, carried some of these parasites. The period of infestation has not been determined. Some interesting facts regarding the longevity of the members of this species have been gathered. A number of turtles for experimental purposes were placed in an aquarium in the month of October. These received no food whatever. The last of February of the following year one of these animals was examined and revealed an infestation of over seven hundred immature specimens of *N. emydis* (Leidy). Two months later another turtle was found to be the host of five *Neorhynchi* of the same species all of which had attained approximately the maximum body size for the species. The fact that there was no mixture of immature and mature forms in the same host would tend to indicate that during this period of starvation no new parasites were introduced into the intestine, probably explicable on the grounds that an intermediate host is required for the reinfestation of the final host, though the actual presence of such has never been demonstrated for any American species. These same facts seem to indicate beyond the possibility of a doubt that these parasites are capable of living entirely at the direct expense of the host, for during a period of six months these worms had not only continued to exist but had proceeded to develop into fully mature individuals when the host was undergoing starvation. No attempt has been made to estimate the influence of inanition of the host upon the length of time required for the parasites to attain sexual maturity.

Neorhynchus cylindratus n. sp.

Large Neorhynchi, bodies almost straight. Females 10–15 mm. long, maximum breadth a short distance caudad of proboscis, 0,7 mm. Males 4,5–8,5 mm. long, maximum breadth located as in females, 0,5–0,7 mm. Proboscis subglobular, slightly broader than long, length 0,149 mm., width 0,172 mm. Hooks in three circles, six hooks to a circle, those in adjoining rows alternating. Terminal hooks 0,079–0,097 mm. long, sharply recurved, strong, 0,014 mm. thick at base, root 0,058 mm. long, 0,029 mm. wide. Middle row 0,037 mm. long, 0,005 mm. thick at base. Basal row 0,021–0,025 mm. long, 0,003 mm. thick at base. Embryos 0,049–0,051 mm. long, 0,015–0,021 mm. broad. In intestine of *Micropterus salmoides* (Lacép.), Pelican Lake, Minnesota.



Figure 4. *N. cylindratus* n. sp. Proboscis ($\times 145$), hooks ($\times 465$), embryos ($\times 465$). Camera lucida drawing.

There is but very little indication of the crescentic shape in the bodies of *N. cylindratus*. Moreover the maximum diameter of the body instead of occupying a region in the middle or anterior third of the body is located just a short distance behind the base of the proboscis. From this maximum diameter the body tapers gradually posteriad to about one third the maximum diameter at the posterior tip. The anterior end narrows rapidly to the point of union of the proboscis and body where the diameter is one fourth the maximum diameter. The hooks while of the general type of those found in *N. emydis* and *N. tenellus*, differ from each of these in rather important details of size and proportions. The basal row of hooks in *N. emydis* may almost equal the second row while in *N. cylindratus* and *N. tenellus* the basal hooks are considerably shorter than those of the middle row. The terminal hooks of *N. cylindratus* are shorter than those of *N. tenellus*. The subcuticula is 0,075 mm. thick. The circular canals or lacunae contained within this tissue at times form an irregular network of small branches. The

lemnisci are straight sacs about one sixth to one fourth the length of the body cavity. The proboscis receptacle in a full grown individual is about 0,45 mm. long. The muscle layer of which its wall is composed has a thickness of 0,032 mm. In the middle of the base of this receptacle is located the brain, a conical mass of tissue the apex of which is directed cephalad.

The two testes are crowded closely together. The anterior one is usually the larger, 0,70 mm. long by 0,26 mm. wide, while the posterior testis is but a little smaller. The cement gland is a very much elongated rectangular mass of tissue which fills the greater part of the body cavity just posterior to the hind testis. It has a length of 1,05 mm. The reservoir of this gland is about 0,035 mm. long.

In no case has a female of this species been found in the stage before the breaking up of the ovary. The embryos show but slight deviation from the ordinary dimensions of $0,049 \times 0,021$ mm. The genital opening is ventral and subterminal.

The material upon which this species has been founded consists of forty-one mature individuals from the black-bass, *Micropterus salmoides* (Lacép.) at Pelican Lake, Minnesota. For this material the writer is indebted to Dr. George R. La Rue. Materials received also from Professor Linton and identified by him as probably »*Echinorhynchus agilis*« have proved to be of the species *N. cylindratus*. This makes it necessary to include the eel, in the vicinity of Woods Hole, Mass., among the hosts of this parasite. Since all the specimens the writer has seen are fully mature it is not possible to present any data concerning the period of infestation.

Neorhynchus tenellus n. sp.

Body small, both ends strongly curved toward ventral, posterior half or two thirds noticeably attenuated. Females 3,5—5 mm. long, maximum breadth 0,280 mm. Males 2 mm. long, maximum breadth 0,280 mm. Proboscis short, cylindrical, length about 0,150 mm., breadth 0,135 mm. Three circles of hooks, six in a circle. Hooks in adjacent rows alternating. Terminal hooks 0,090—0,110 mm. long, middle row 0,038 mm. long, basal row 0,027 mm. long. Embryos not found in any of specimens examined. Egg-masses small, $0,043 \times 0,027$ mm.

The body form of this species is so strikingly different from that found in other Neorhynchi that while the writer is loath to attribute any marked value to body form and size as diagnostic characters at least in this instance it seems necessary to make mention of the characteristic attenuation of the body in the posterior region as contrasted with the more nearly uniform body diameter found in other members of the

genus. In some species an enlargement of the anterior region of the body has been noted as due to the accumulation of egg-masses and embryos of the gravid female, but in *N. tenellus* this enlargement could not be the result of a mere physical effect of this nature since the same condition appears in males and in immature females also. The small number of individuals upon which the specific description was founded prevents an accurate determination of the limits of body size, and while the known limits are included within narrow bounds later study may alter these figures. The color of these small worms is translucent milky white.

While the terminal hooks vary but little from those already described for *N. emydis* the size of the basal hooks is distinctly different.



Figure 5. *N. tenellus* n. sp. Proboscis ($\times 145$), hooks ($\times 465$). Camera lucida drawing.

The fact that the terminal hooks frequently exceed those of *N. emydis* in size while the basal hooks are constantly smaller than those of *N. emydis* precludes the possibility that the material upon which this species has been founded might be specimens of *N. emydis* whose growth had been retarded. The result of such a retardation in development would in all probability affect the various parts of the body equally so that if one row of hooks were smaller than normal the other rows on the same proboscis would in like manner be reduced.

The cuticula and subcuticula are both slightly developed. The subcuticula is 0,015—0,025 mm. thick. The lemnisci have a length of about 0,87 mm., or over three times the length of the proboscis receptacle, whose length is 0,26 mm. The brain is located in the middle of the base of the proboscis receptacle. The testes are oval in shape. In the specimens measured they are 0,21 mm. long with a width of 0,12 mm. The cement gland is 0,26 mm. long and 0,07 mm. wide. This gland empties its secretion into a cement reservoir of sac-like form as typical for other members of the genus.

Two pickerel, *Esox lucius* Linn., taken from Lake Marquette at

Bemidgi, Minnesota, Sept. 8, 1911 contained a number of these parasites in the intestines. The worms were collected by Hermann Douthitt who kindly gave some of them to the writer.

In his key to the Acanthocephala Lühe (1911) recognizes but a single species of *Neorhynchus*, *N. rutili* (O. F. Müller), as occurring in central Europe. Consequently his key which is purely an artificial device for use in connection with forms within the scope of his work succeeds only in setting off this one form from the other Acanthocephala under consideration. At the beginning of this paper I have given a diagnosis of the characters of the genus *Neorhynchus*. In the following key to the species only American forms have been considered. Failure to include the European species in this key is due to the fact that considerable confusion exists as to the absolute identification of the two described species which the writer hopes to make clear in a later paper. In so far as possible only purely diagnostic points have been introduced into this key.

- 1) [8] Proboscis with three circles of hooks 2
- 2) [3] Twelve hooks in a circle . . . *Neorhynchus gracilisentis* n. sp.
- 3) [2] Six hooks in a circle 4
- 4) [7] Terminal hooks over 0,090 mm. long 5
- 5) [6] Basal hooks over 0,030 mm. long (0,035—0,054 mm.)
Embryos 0,016 × 0,011 mm.
Body 8—32 mm. long . . . *Neorhynchus emydis* (Leidy)
- 6) [5] Basal hooks under 0,030 mm. long
Body 2—5 mm. long . . . *Neorhynchus tenellus* n. sp.
- 7) [4] Terminal hooks under 0,090 mm. long
Basal hooks 0,020—0,025 mm. long
Embryos 0,049—0,051 mm. × 0,015—0,021 mm.
Body 4—15 mm. long . . . *Neorhynchus cylindratus* n. sp.
- 8) [1] Proboscis long, armed with numerous hooks in irregular circles of usually about six hooks each
Neorhynchus longirostris n. sp.

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