

breiter als außen lang. Innere Linien der Pleuren gegen das Coxosternum sehr schräg verlaufend. Hinter den Gelenknötchen fehlen die Muskelkanten oder Seitenlinien völlig. Vorn am Coxosternum giebt es keine Zähnen. Beborstung des Körpers spärlich und sehr kurz. Die Bauchplatten besitzen vor dem Hinterrande ein sehr schmales Drüsenporenband (Fig. 3). In diesem Drüsenfelde, welches gegen die Umgebung deutlich abgesetzt ist, fehlt die Zellstructur größtentheils vollständig. Von der 19. Ventralplatte an rücken die Poren durch eine mittlere Unterbrechung in 2 Querhaufen aus einander, diese bleiben aber bis zum Praegenitalsegment wohl entwickelt. Von der 3.—21. V. bemerkt man vorn eine kleine Grube *gr* und hinten einen in die Grube eingreifenden Höcker *h*.

Am Praegenitalsegment kommen die Endbeinhüften (Fig. 4), hinter der Bauchplatte fast zur Berührung. Jederseits finden sich 9 Coxaldrüsen von verschiedener Größe, welche außer den beiden vordersten frei münden. Analdrüsen deutlich. Endbeine mit kräftigen Krallen.

Vorkommen: Diese interessante auffallende Form muß in dem doch schon viel durchsuchten Südtirol recht selten sein. Das einzige ♀ erbeutete ich im October 1899 bei Mori am Nordostabhang des Mt. Baldo in einem Laubwalde unter Moos. Ich habe es dem Berliner Museum für Naturkunde gegeben, wo es sich in Gestalt eines mikr. Praeparates befindet.

10. August 1901.

3. Observations on the so-called Dimorphism in the males of *Cambarus* Erichson¹.

By J. Arthur Harris, Lawrence, Kansas.

eingeg. 14. August 1901.

The existence of two markedly different forms of males in the genus *Cambarus* Erichs.¹, a fact first noticed by Louis Agassiz and Henry James Clark², has long been recognised.

Dr. Hagen in his monograph³, whenever material was available, described both forms of males, designating them as Form I and

¹ The substance of this paper appears in a more detailed form, with a table showing the condition of the testes of all the individuals examined in the Kans. Univ. Quart. Vol. X. No. 2. April 1901.

² See Faxon, Walter, On the so-called Dimorphism in the genus *Cambarus*. Amer. Journ. Sc. Vol. XXVII. p. 42—44.

³ See Hagen, Hermann A., Monograph of the North American *Astacidae*. Ill. Cat. Mus. Comp. Zool. Harvard Coll. 1870. p. 22.

Form II. Since that time, in taxonomic work, a complete description has always covered both forms of the male.

The external differences between the first- and second-form males have been well described by Hagen⁴ and Faxon⁵.

The differences affect more especially those structures directly concerned in the act of coition — the first pair of abdominal appendages and the hooks on the ischiopodite of the third, or in some species, of the third and fourth pairs of legs. In the second-form, the hooks are much smaller than in the first-form and probably are incapable of performing their function of attaching the male to the female during the act of coition. The first abdominal appendages in the second-form have almost the structure seen in the young males of the species. In the first-form the articulation at the base is gone and the terminal hooks are more widely separated and horny. In those species in which the tip is bifid, the second-form appendage is divided but a very short distance and the ends are blunt, while in the first-form they are distinctly separate for about half the length of the appendage and are slender and horny. In the general form of the body the second-form approaches that of the female; the sculpture of the whole body is less pronounced and the chelae are seen to be decidedly more slender and weaker than in the first-form. After a certain size has been reached — all young specimens being second-form — no relation exists between the form and the size of the individual, the second-form specimens being large and the first-form small or vice versa.

Dr. Hagen made an anatomical examination⁶ of first and second-form males of *C. acutus* Girard, *C. virilis* Hagen and *C. Bartonii* Fabricius. His observations were made from a very limited number of specimens — probably only two from each species — and no note was made of the time of year the material was taken, a condition the significance of which he seems to have entirely overlooked. His observations were that the testis was decidedly larger in the first than in the second-form. Hagen's idea was, that in the older males of the second-form the sexual organs had failed to develop, and are consequently non-functional.

The size of the arthropod testis, of course, depends largely upon the condition of the sexual elements — being, for instance, larger when the sperm cells are in the spermatocyte stages than when the

⁴ Hagen, loc. cit.

⁵ Faxon, loc. cit. also: A Revision of the *Astacidae*, Part I. Mem. Mus. Comp. Zool. Vol. X. No. 4. 1885.

⁶ Hagen, loc. cit. p. 22—24.

spermatozoa are mature and of course, smaller still after the testis has been evacuated.

So far as I have been able to observe, the testes of first- and second-form males of the same size, taken at the same season of the year, are equally developed. It being impossible to tell from the testes alone whether the animal was first- or second-form.

Faxon⁷ observed that the so-called first- and second-form males were only alternating stages in the life of the individual. First-form males of *C. rusticus* Girard, kept in his laboratory copulated freely and soon after exuviated. Later examination showed that the casts were first-form while the animals themselves were second-form. He noticed practically the same thing for *C. propinquus* Girard.

I have had the opportunity of making quite extensive field observations on *C. immunis* Hagen. In the late summer and autumn, the proportion of first-form males gradually increases, there seeming to be, so far as I have yet been able to observe, no definite time at which the exuviation takes place. By late September or early October practically all are in the first-form condition. Copulation probably takes place with this species in the fall. Early in March the males, still first-form, emerge from their burrows and inhabit the stagnant ponds, remaining in first-form condition until about April 20. At this time almost all are found to be ready to exuviate, the animal in its new condition being second-form. When the old shell is slipped from first-form specimens which are almost ready to exuviate the appendages of the animal in its new form are seen to be clearly second-form. Somewhat less extensive observations lead me to believe that in *C. virilis* Hagen the process is essentially the same. Thus my somewhat more extended observations confirm Dr. Faxon's important discovery that the first- and second-form are only alternating phases in the life of the same individual.

Three specimens which have come under my observation are deserving of especial attention. The first — a specimen of *C. immunis* — exuviated April 29, 1901, the same day it was taken. An examination of the animal and of the cast plainly showed that the cast was perfectly-formed second-form as was also the animal in its new condition. In the case of the second individual, I did not secure the cast but took the animal itself while it was yet very soft from exuviation. It was clearly first-form and since, with the exception of the one specimen mentioned above, no second-form males, except those which had recently exuviated, were taken this spring, there is a strong probability

⁷ Faxon, On so-called Dimorphism.

that this individual had been in the first-form condition before exuviation. The third animal — a moderately large second-form *C. virilis* was taken while still soft from moulting September 4, 1900. Since it had assumed the second-form condition just at the period when all others were becoming first-form, it seems not at all improbable that it would also represent one of those which retain the same form after exuviation as before. With the possible exception of the last, these specimens were all unquestionably old enough to show the regular alternation of forms.

Faxon, in his paper on Dimorphism, says: „I will add that the males of extraordinary size which I have seen are all of the first-form. Do these very old individuals cease to moult? Do they become permanently capable of reproduction?” While the most of the very large males I have seen have been first-form I have seen some very large second-forms and so must very much question the correctness of such a theory. I may add, however, that it seems to me decidedly more probable that the very old individuals should exuviate but remain continually in the first-form condition than that they should cease to exuviate altogether.

No dimorphism in the males has been observed in *Astacus*, nor has any indication of it been found in any other genus of the *Astacidae*, unless it be in the subgenus *Cambaroides* where Faxon⁸ suspects the presence of two forms of the male as in *Cambarus*. Should this be found to be true, it would certainly be of great interest from a phylogenetic point of view.

A fact which has not heretofore been considered seems to me significant. In *Astacus*, according to Chauveau⁹ after the third year the males moult twice, first in June and July, afterwards in August and September, and the females once, from August to September annually. According to Huxley¹⁰, copulation takes place immediately after the completion of ecdysis in the early autumn. It is to be observed that if the alternation of forms in *Cambarus* noticed by Faxon, occurs regularly year after year, which my observations tend to show for both

⁸ Faxon, Monograph, p. 227.

⁹ Chauveau, S., 1) Observations sur la formation des pierres chez les écrivisses. Compt. Rend. T. 78. p. 665—667. 2) Sur le mécanisme de la dissolution intrastomacale des concrétions gastriques des écrivisses. Compt. Rend. T. 79. p. 1230—1231. Also (3 and 4) Observations sur l'histoire naturelle des écrivisses. Compt. Rend. T. 69 and 73.

I have not seen these papers, but make the statement on the authority of Dr. C. L. Herrick. The American Lobster. Bull. U. S. Fish Com. Vol. XV. Washington, 1896. and Huxley. F. H., The Crayfish.

¹⁰ Huxley, loc. cit.

C. immunis and *C. virilis*, the parallel between the two is quite striking; the spring ecdysis of *Astacus* corresponding to that which brings *Cambarus* into the second form after copulation, while the autumn ecdysis of *Astacus* corresponds to that which brings *Cambarus* back into the form in which it is ready to approach the female.

Neither Hagen's nor Jaxon's material was in condition, having lain so long in Alcohol, for microscopic determination of the character of the contents of the testis. My object in this study has been to supply observations on this point, hoping, by a careful comparison of the sexual organs, to get some idea of the relation of the reproductive elements to the physical condition of the animal and so come a little nearer to the determination of the true significance of the occurrence of the two forms. My material was prepared by the usual cytological methods; Flemming's fluid was used as a fixative and Heidenhain's Iron-Haematoxylin and the Safranin-Gentian, Violet-Orange, and Combination were used principally as staining reagents.

I have carefully examined sections of the testes of thirty seven individuals taken at various times throughout the year. Some periods are not represented, yet I feel sure that the material so far studied warrants me in drawing the conclusions given in this paper. I expect, however, to complete my series of testes as soon as possible and shall then publish the results obtained from a study of the condition of testes throughout the year. In many cases all three lobes and the vas deferens were examined; in others, sections were prepared from only one or two of the lobes or the vas deferens. It is, of course, unnecessary to state that in drawing comparisons between individuals, care was taken to have the size and general physical condition of the specimens as nearly the same as possible.

Examination of material taken in late July and in August shows about the following condition. At the proximal end of the testis are a few emptied follicles. Back of this is a region of follicles containing spermatids in various stages of transformation, the earlier stages being, for the most part, toward the distal end. The spermatid region extends usually somewhat more than one half the length of the lobe. Then follow spermatocytes, of which two or more follicles are often seen to be in active mitosis, and finally a zone of spermatogonia about one sixth of the length of the lobe in width. An occasional spermatogonial division figure is to be seen. The vas deferens is partially filled with spermatozoa.

The above is the condition found in both first- and second-forms and a very careful examination of material from seventeen individuals collected from July 27 to Aug. 31 did not reveal any differences which

may not be attributed to individual variation between the first and second form. Size of testis as a whole, number of mature elements present, stage and number of spermatids, and mitotic activity seem to be the same whether the testis comes from first- or second-form.

In the spring, as in the late summer, the condition of the testes of first- and second-form show practically the same condition: a proximal area of emptied follicles followed by one in which they contain apparently the original number of mature spermatozoa with an occasional follicle containing spermatocytes in fine spereme condition, separating the area of spermatozoa from the distal spermatogonial region, where occasional division figures are to be observed. The vas deferens is well filled with spermatozoa, retaining them for several days after the animal has passed from first to second form.

The above described lot of material tends to show that the main part of the regeneration of the male sexual elements takes place between the spring exuviation, in which the animal assumes the second form, and late in August, during the latter period of which time the animal may be in either of the forms.

While advancing this theory rather tentatively it seems to me that from the evidence at hand we must conclude that the second-form represents the period in each year's life of the adult individual in which the greater part of the regeneration of sexual elements takes place, but that the limits of this period are very indefinitely fixed. In other words the sexual condition of the male is not the only factor to be taken into consideration, as is well shown by the variation observed in the testes of individuals in the same form as well as by the occurrence of individuals in which the alternation of forms does not occur regularly.

Our present knowledge of the Dimorphism in the males of *Cambarus* may be briefly summarized as follows:

1) The Alternation of Forms which Faxon observed for *C. rusticus* Girard and *C. propinquus* Girard has been shown for *C. immutabilis* Hagen and without doubt occurs in *C. virilis* Hagen.

2) Exceptions to this Alternation of Forms are to be found in adult individuals.

3) No difference can be detected between the testes of first- and second-form males taken at the same time of year either as regards gross anatomy or microscopic structure, as far as the presence of the sexual elements is concerned, therefore, the second-form male is as capable of copulation as is the first-form.

4) The second-form condition probably represents in the adult

individual the period in which the greater part of the regeneration of the sexual elements takes place.

5) The parallel between the first- and second-form males in *Cambarus* and the spring and fall exuviation of *Astacus* is probably not without significance.

I wish to express here my gratitude to Prof. C. E. McClung and Mr. W. S. Sutton of the Department of Zoology and Histology, University of Kansas, where the work was done, for useful suggestions.

Laboratory of Zoology and Histology, University of Kansas, July 1, 1901.

4. Einige Beobachtungen über die Entwicklungsgeschichte von *Distomum folium* Olf.

(Vorläufige Mittheilung.)

Von D. Th. Ssinitzin, Custos am zoologischen Cabinet der Kaiserlichen Universität zu Warschau.

eingeg. 15. August 1901.

Die Entwicklungsgeschichte des *Distomum folium*, welches in der Harnblase und im Harnleiter verschiedener Fische¹ parasitiert, war bis jetzt noch unbekannt. Die Frage über den Zwischenwirth dieses *Distomum*, ebenso wie die Art und Weise der Inficierung der Fische, war noch eine offene geblieben. Looss sprach die Vermuthung² aus, daß *D. duplicatum*, welches in *Anadonta anatina* von Baer³ entdeckt und beschrieben wurde, die *Cercaria* des *D. folium* sei. Diese Annahme begründete Looss mit der Ähnlichkeit im anatomischen Bau zwischen *D. duplicatum* und *Cercaria macrocerca* (= *D. cygnoides*) einerseits, und *D. folium* und *D. cygnoides* andererseits. Leider hatte ich bis jetzt keine Möglichkeit, mich mit der von Looss erwähnten Baer'schen Arbeit bekannt zu machen, aber nach der Abbildung zu urtheilen, welche Pagenstecher⁴ von *D. duplicatum* giebt, und welcher es irrthümlicherweise für die *Cercaria* von *D. cygnoides* hält, kann ich bestätigen, daß die Looss'sche Annahme eine irrthümliche ist und daß Baer's *D. duplicatum* dem *Cercaria*-Stadium irgend eines anderen *Distomum*, aber nicht *D. folium* zugehört.

Die Entwicklung des *D. folium* vom *Miracidium*-Stadium bis zum

¹ In der Harnblase des *Esox lucius*, *Thymallus vulgaris*, *Trutta variabilis*, *Salmo umbla*, *Cottus gobio* und im Harnleiter der *Acerina cernua*. Außerdem fand ich es im Harnleiter und in der Harnblase einiger karpfenartiger Fische (Cypriniden).

² Looss, A., Die Distomen unserer Fische und Frösche. 1894. p. 23.

³ v. Baer, K. E., Beitrag zur Kenntnis der niederen Thiere. Nov. Act. Acad. Caes. Leop. XIII. 1827.

⁴ Pagenstecher, Trematodenlarven und Trematoden. Heidelberg, 1857. p. 29. tab. IV. fig. XIV.

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