Mémoires de l'Académie Royale des Sciences et des Lettres de Danemark, Copenhague,
Section des Sciences, 9me série t. V. n° 1.

KREUZBEIN, BECKEN
UND *PLEXUS LUMBOSACRALIS* DER
VÖGEL

VON

J. E. V. BOAS

MIT 15 TAFELN UND 33 FIGUREN IM TEXT

D. KGL. DANSKE VIDENSK. SELSK. SKRIFTER, NATURV. OG MATH. AFD., 9. RÆKKE, V. 1.

KØBENHAVN
LEVIN & MUNKSGAARD
1933

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INHALT

1. Das Kreuzbein.

Als Kreuzbein der Vögel bezeichnen wir die ganze Sammlung von mit einander beim ausgebildeten Vogel verwachsenen Wirbeln, mit welcher das Becken verbunden ist.

Die Behandlung desselben veranlasst mich zunächst einige allgemeinere morphologische Bemerkungen bezüglich gegliederter Organe vorauszuschicken.

a. Einige Bemerkungen bezüglich der Homologisierung der Elemente gegliederter Organe und speziell der des Kreuzbeins der Vögel.

Wenn wir ein gegliedertes Organ, z. B. eine Wirbelsäule, irgend eines Tieres mit demselben Organ eines anderen, verwandten Organismus vergleichen, erhebt sich eine Schwierigkeit bezüglich der Homologien, wenn die zwei Organe, also in dem gewählten Beispiel die zwei Wirbelsäulen, aus einer verschiedenen Anzahl Glieder, in dem gewählten Beispiel also Wirbel, zusammengesetzt sind. Finden wir dann, dass in der einen Wirbelsäule z. B. der 17. Wirbel eine charakteristische Form hat und dieselbe Gestalt in der anderen Wirbelsäule nicht dem 17. Wirbel, sondern vielmehr dem 19. Wirbel angehört, entsteht die Frage: ist der 17. Wirbel des einen dem 17. Wirbel des anderen homolog und die gleiche Ausbildung des 17. des einen und des 19. des anderen unabhängig entstanden — oder sind der 17. des ersteren und der 19. des letzteren einander homolog? Beide Möglichkeiten haben ihre Anhänger: die Anhänger der letzten Deutung, z. B. Jhering (l.c.), sind der Auffassung, dass es sich um Intercalation, resp. Excalation, von Wirbeln handelt; die Anhänger der ersten Deutung, z. B. Bütschli (l. c. p. 215) verneinen, dass eine Intercalation stattfindet, und sind der Meinung, dass eine Vermehrung der Wirbelzahl stets nur am hintersten Ende der Wirbelsäule stattfindet.

Nach meiner Auffassung, die ich speziell für die Vogel-Wirbelsäule ausführen werde, liegt die Sache folgendermassen:

Abgesehen von den zwei ersten Wirbeln, Atlas und Epistropheus, kann man überhaupt nicht von einer Homologie einzelner bestimmter Wirbelnummern verschiedener Vögel reden. Es besteht in Bezug auf die Wirbelsäule der Vögel eine gewisse erbliche Tendenz zur Ausbildung einer bestimmten Reihe von charakteristischen homologen Abschnitten. Die Abschnitte sind folgende: 1. Erster Halsabschnitt. 2. Zweiter Halsabschnitt. 3. Dritter Halsabschnitt. Diese drei Halsabschnitte sind jeder durch charakteristische Züge unterschieden[1]). 4. Brustwirbelabschnitt. 5. Kreuzbein mit mehreren Unterabteilungen, die unten erwähnt werden. 6. Die freien Caudalwirbel mit dem charakteristischen Endknochen.

Die Zahl der Wirbel jedes Abschnittes ist wechselnd. Wenn man in einem Abschnitt bei einem Vogel eine grössere Anzahl von Wirbeln findet als bei einem anderen, verwandten fasse ich es nicht derart auf, dass von einer Intercalation von Wirbeln die Rede ist, im Allgemeinen auch nicht so, dass Wirbel des folgenden Abschnittes in denselben aufgenommen sind, sondern derart, dass der Abschnitt überhaupt nicht an eine ganz bestimmte Zahl gebunden ist; der Abschnitt ist dem ähnlichen anderer Vögel homolog; wenn bei einem Vogel eine grössere, bei einem anderen eine geringere Anzahl Wirbel in einem Abschnitt vorhanden ist, handelt es sich um eine verschiedene Gliederung desselben. Wenn im *Cygnus* in dem ersten Halsabschnitt 13, im zweiten 8, im dritten 3 Wirbel sitzen, während der verwandte *Anser domesticus* resp. 8, 6 und 3 besitzt, bedeutet es nicht, dass im I. Abschnitt bei Cygnus eine unmässige Anzahl Wirbel intercaliert sind, auch nicht, dass der I. Abschnitt desselben den II. Abschnitt der Gans verschlungen hat, sondern einfach dass der I. Abschnitt von Cygnus in Anpassung an die eigenartige Verwendung des Halses[2]) sich reichlicher gegliedert hat; der I. Abschnitt des Schwans ist dem I. der Gans homolog, der II. dem II., der III. des Schwans dem III. der Gans. Diese reichlichere Gliederung der Abschnitte des Schwanenhalses ist ganz der Variabilität an die Seite zu stellen, die in der Zahl der Glieder in den Blätter-Kreisen der Blumen gewisser Pflanzen gefunden wird. Bei den Monocotylen bestehen diese Kreise ja sehr allgemein aus je drei Blättern; man kann aber Exemplare von Tulpen finden, die vierzählig sind, was auch regelmässig bei Paris quadrifolia der Fall ist, und bei dem kleinen Majanthemum bifolium bestehen die Blätter-Kreise der Blume aus je zwei Blättern: der vierzählige oder zweizählige Blätterkreis ist dem gewöhnlichen dreizähligen homolog. Auch bei Dicotylen findet man dasselbe: bei Gloxinia ist gewöhnlich ein Kreis von 5 Kronenblättern vorhanden; man findet aber auch Exemplare von Gloxinia-Blumen, die mit derselben Regelmässigkeit 6 oder 7 Kronenblätter besitzen. In allen diesen Fällen ist einfach von einer stärkeren oder geringeren Gliederung der Blätter-Kreise die Rede.

Ich halte also die oben genannte von manchen gehegte Auffassung, nach welcher z. B. Wirbel Nr. 17 stets derselbe sein sollte, für nicht richtig und auch für wenig natürlich. Sie postuliert exzessive Umbildungen von Wirbeln, wenn wir von einer Form zur anderen gehen: bei Cygnus z. B. würden die Halsabschnitte die gesammten Brustwirbel anderer Lamellirostres verschlungen haben, u. s. w.; Gruppen von Wir-

[1]) Vergl. meine Arbeit über den Vogelhals p. 106 u. flg.

[2]) Vergl. meine Vogelhals-Arbeit p. 121.

beln, z. B. Teile des Kreuzbeins, die ganz ähnlich bei den verschiedenen Formen sind, sollten nach dieser Theorie nur analoge Ausbildungen sein; die Theorie würde auch weitgehende Umänderungen anderer Organsysteme, z. B. des peripheren Nervensystems, voraussetzen. Natürlicher finde ich die andere Theorie von Intercalationen, resp. Excalationen; aber auch diese macht einen dogmatischen Eindruck. Ganz einfach und natürlich dürfte dagegen die hier vertretene Auffassung im Allgemeinen sein, nach welcher es sich um eine schwächere oder stärkere Gliederung handelt, um eine Zahlen-Variabilität.

Die Variabilität in der Zusammensetzung des Kreuzbeins der Vögel entstammt teils der erwähnten Labilität der Wirbelzahl der einzelnen Abschnitte, von denen im Kreuzbein vier unterschieden werden können, teils anderen Ursachen, besonders der dass am vorderen und hinteren Ende eine verschiedene Anzahl Brustwirbel, resp. Caudalwirbel in das Kreuzbein aufgenommen sein kann.

b. Beschreibung des Kreuzbeins, Einleitung.

Die Kreuzbein-Wirbel, die bei dem jungen Vogel noch getrennt sind, später aber alle verwachsen, bestehen natürlich aus Körper und Dorsalbogen. Die Dornfortsätze sind meistens nur an den vordersten Wirbeln deutlich entwickelt (sie sind hier verwachsen), weiter nach hinten werden sie allmählich niedriger und schliesslich ganz ausgewischt; nur die hintersten können wieder deutlich sein. Nur die Ratiten (Tab. 8, machen eine Ausnahme, indem die Dornfortsätze bei ihnen alle deutlich sind. Bei der Verwachsung der Wirbel fehlen die Gelenkfortsätze durchweg, nur die am Vorderende des ersten Wirbels sind vorhanden (an dem letzten Kreuzbeinwirbel, wo allenfalls die hinteren Gelenkfortsätze vorhanden sein könnten, fehlen sie). Von grösstem Interesse für uns sind die Querfortsätze (Textfig. 1). Dieselben entspringen wie gewöhnlich von dem Bogen, der Ursprung kann sich aber auf den Wirbelkörper hinab erstrecken, und unter solchen Umständen kann der Querfortsatz von einem grossen Loch durchbohrt und in einen dorsalen und einen ventralen Ast getrennt werden, die entweder nur an dem Ursprung zusammenhängen, resp. auch hier getrennt sind, oder auch noch an dem peripheren Ende vereinigt sind. An einigen Stellen des Sacrum haben die Querfortsätze den Charakter als wären es solche, deren Ventralast verloren gegangen und nur der Dorsalast übrig geblieben (Tab. 1, Fig. 5 u. 9), und manchmal können an solchen Wirbeln Überreste des Ventralastes vorkommen (vergl. den II. Kreuzbein-Abschnitt). Die Enden der Querfortsätze heften sich an das Becken.

Die Kreuzbein-Wirbel können in 4 Abschnitte geteilt werden (Tab. 5 etc). Der I. Abschnitt (Tab. 1, Fig. 1—3 u. 6), meist aus 4—6 Wirbeln bestehend, von denen der erste oder die ersten bewegliche Rippen tragen, ist mit starken kurzen Querfortsätzen versehen, die sich mit grosser Endfläche an das Ilium heften; von diesen entspringt der letzte derartig von dem Wirbel, dass seine Ventralseite etwa in demselben Niveau wie die Ventralseite des Wirbelkörpers liegt (Tab. 1, Fig. 3 u. 6); häufig ist dieser Querfortsatz in einen dorsalen und einen ventralen Ast gespalten. Wir nennen den Wirbel, der diesen Querfortsatz trägt, α; die vorangehenden resp. β, γ, δ, etc. von hinten gerechnet.

Der II. Abschnitt (Tab. 1, Fig. 4, 5, 9) besteht meist aus 3—7 Wirbeln, die am besten kurz derartig charakterisiert werden können, dass die Querfortsätze den Anschein haben, als ob es gespaltene Querfortsätze sind, deren Ventralast fehlt, so dass nur der schwache dorsale Ast, der ganz oben entspringt und sich an den Rand des

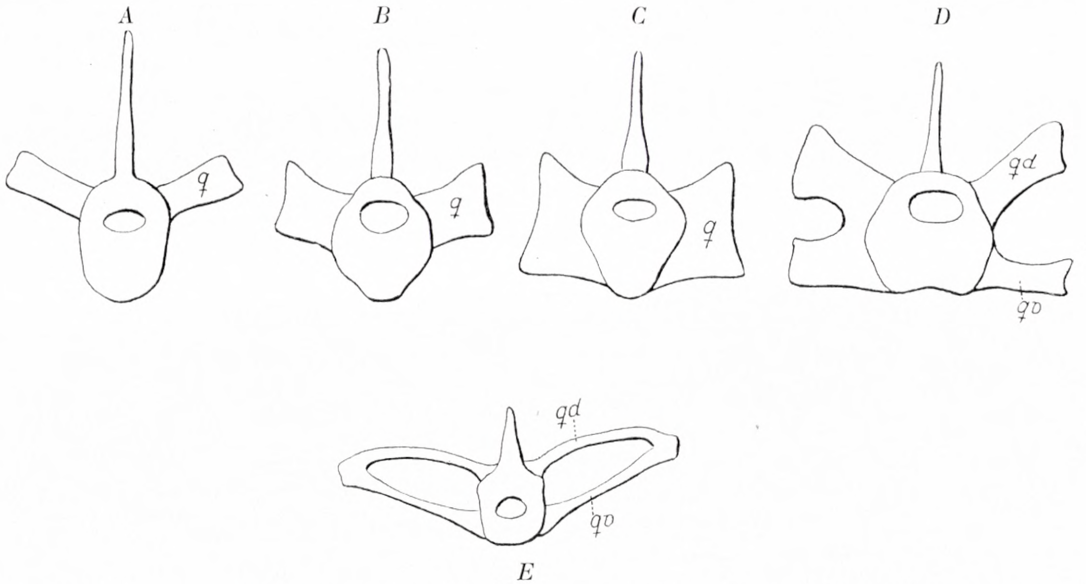

Fig. 1. Schemata zur Erläuterung der Entwicklung der Querfortsätze an verschiedenen Wirbeln des Vogel-Kreuzbeins. *A*: der Querfortsatz (*q*) entspringt von dem Bogen. *B-C*: der Ursprung erstreckt sich in verschiedener Ausdehnung auf den Wirbelkörper. *D-E*: ein Loch oder eine Bucht von verschiedener Grösse hat sich in dem Querforsatz gebildet und denselben in zwei Äste gespalten, einen dorsalen, *qd*, und einen ventralen, *qv*.

Ilium heftet, übrig geblieben ist. Manchmal kann jedoch der vorderste von ihnen einen mehr oder weniger entwickelten Ventralast besitzen (Tab. 4, Fig. 3), und auch an dem letzten kann ein solcher vorhanden sein (Tab. 4, Fig. 4).

Der III. Abschnitt (Tab. 1, Fig. 7, 10, 11) umfasst zwei Wirbel, die typisch mit langen starken Querfortsätzen versehen sind, die in einen dorsalen und einen ventralen Ast gespalten sind, die sich an ihrem distalen Ende vereinigen und oft sehr innig mit dem Ilium verbinden. Diese Wirbel werden von Gegenbaur mit den Buchstaben *a* und *b* bezeichnet, Bezeichnungen, die wir ebenfalls behalten werden.

Der IV. Abschnitt umfasst eine verschiedene Anzahl von Wirbeln, von denen namentlich die ersten sich eng an die des III. Abschnittes anschliessen, nur sind die Querfortsätze kürzer und meist nicht in einen Dorsal- und Ventralast gespalten. Die letzten Wirbel des Abschnittes weichen mehr oder weniger ab (vergl. die speziellere

Beschreibung des Abschnittes). Die Wirbel dieses Abschnittes bezeichnen wir mit den Buchstaben *c*, *d* etc.

Es fragt sich nun zunächst: welche von den zahlreichen Wirbeln des Vogel-Kreuzbeins entsprechen den beiden Sacral-Wirbeln der Reptilien, deren Abkömmlinge die Vögel ja sind?

Zur Zeit dürfte die von Gegenbaur (1871) begründete Auffassung die herrschende sein. Nach Gegenbaur sind die Wirbel *a* und *b* (also unser III. Abschnitt) die echten Sacralwirbel, denen der Crocodile und der Saurier entsprechend. Ich bin aber bei meiner Untersuchung, bei welcher ich zunächst von der Gegenbaur'schen Auffassung ausgegangen bin, zu dem Resultate gelangt, dass G. hier nicht das Richtige getroffen hat. Später werden wir die Gegenbaur'sche Deutung näher durchgehen, zunächst aber meine eigenen Resultate betrachten.

Als Wegweiser benutzte ich, wie auch Andere gemacht haben, die Nerven, die aus dem Kreuzbein heraustreten. Und als Ausgangspunkt wähle ich unter den Reptilien nicht wie Gegenbaur die Saurier, sondern die Crocodile, welche unter den jetztlebenden Reptilien unverkennbar diejenigen sind, die den Vögeln am nächsten stehen[1])

Mit Hülfe der Nerven wähle ich den letzten Lumbarwirbel der Vögel aufzusuchen; wenn dieser gefunden ist, ergibt sich von selbst was der erste echte Sacralwirbel ist: es ist nämlich der auf denselben direkt folgende Wirbel.

Bei den Crocodilen (Textfig. 2) wird der Lumbal- oder Cruralplexus, der sich in den Nervus cruralis fortsetzt, aus drei Nervenwurzeln gebildet, die aus den drei letzten präsacralen Nervenöffnungen heraustreten (also aus den Nervenöffnungen zwischen den drei letzten Lumbarwirbeln und aus der zwischen dem letzten Lumbarwirbel und dem ersten Sacralwirbel). Die zweite Wurzel ist die stärkste. Aus der letzten der genannten Nervenöffnungen tritt ausser der dritten Wurzel des Cruralplexus auch noch die erste Wurzel des *Plexus ischiadicus* und die hintere Wurzel des *Nervus obturatorius*, dessen vordere Wurzel aus der vorhergehenden Nervenöffnung heraustritt.

Der letzte Lumbarwirbel der Crocodile ist also dadurch charakterisiert, dass aus der Nervenöffnung hinter ihm die letzte Wurzel des Cruralplexus, die erste Wurzel des Plexus ischiadicus und die letzte Wurzel des Nervus obturatorius heraustreten.

Wir haben demnach zu untersuchen ob es bei den Vögeln einen Wirbel gibt, der dieselben oder ähnliche Verhältnisse darbietet; finden wir einen solchen, haben wir den letzten Lumbarwirbel der Vögel gefunden.

Und einen solchen Wirbel haben wir eben, und zwar ist es derjenige, den wir oben mit dem Buchstaben *α* bezeichnet haben, der letzte Wirbel des I. Abschnittes.

Ebenso wie bei den Crocodilen wird der Cruralplexus bei den Vögeln meistens (Textfig. 3) von drei Wurzeln gebildet, von denen die letzte aus der Nervenöffnung

[1]) Vergl. meine »Phylogenie d. Wirbeltiere« in: Kultur der Gegenwart. Teil III, Abteilung IV, 4 p. 562—63, 1914.

hinter dem Wirbel *α* heraustritt, und aus derselben Öffnung tritt auch die erste Wurzel des Plexus ischiadicus und auch die hinterste Wurzel des Nervus obturatorius, die eine Strecke weit mit der letzten cruralis-Wurzel vereinigt ist und somit als ein Ast der letzteren erscheint, d. h. die obturatorius-Fasern sind zunächst denen der

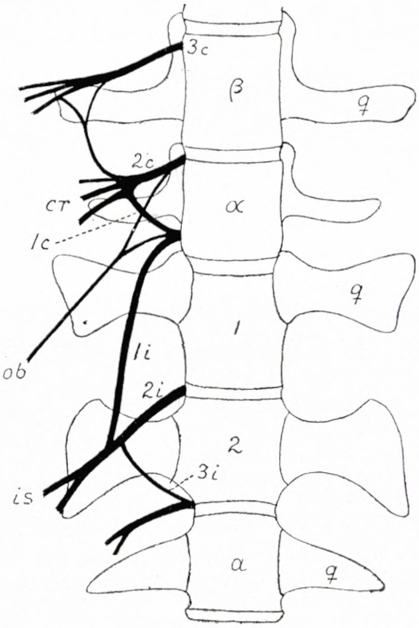

Fig. 2. Schema des Lumbo-Sacralplexus der Crocodile. *a* erster Schwanzwirbel, *1c—3c* die drei Wurzeln des Cruralplexus. *cr* dem Cruralplexus entstammende Nerven. *1i—3i* die drei Wurzeln des Plexus ischiadicus. *is* Nervus ischiadicus. *ob* Nervus obturatorius. *q* Querfortsatze. *α*, *β* letzter und vorletzter Lumbarwirbel. *1*, *2* erster und zweiter Sacralwirbel.

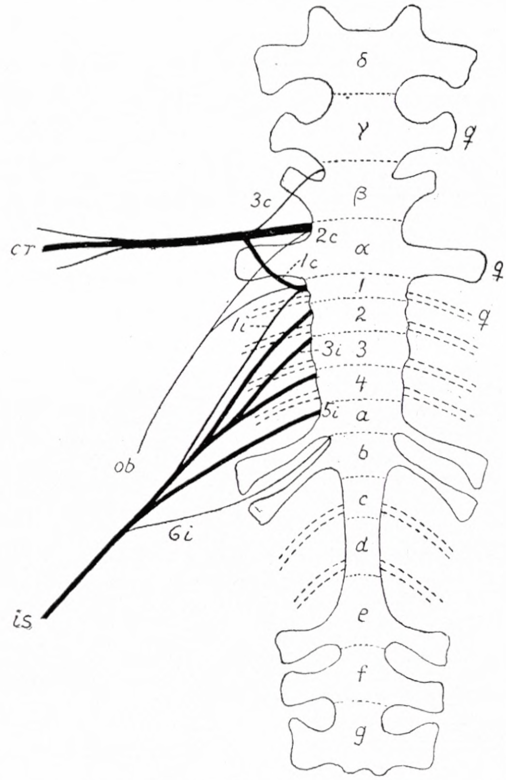

Fig. 3. Schema der typischen Verhältnisse der Lumbo-Sacralplexus der Vögel. *α—δ* die Wirbel des I. Abschnittes. *1—4* die des II. Abschn. *a—b* die des III. Abschn. *c—g* die Wirbel des IV. Abschnittes. *1c—3c* die drei Wurzeln des Cruralplexus. *cr* Nervus cruralis.s *1i—6i* die Wurzeln des Plexus ischiadicus. *is* N. ischiadicus. *ob* N. obturatorius. *q* Querfortsätze.

cruralis-Wurzel dicht angelagert und von einer gemeinsamen Bindegewebe-Hülle mit ihnen umgeben; das worauf es ankommt ist natürlich, dass sie derselben Nervenöffnung entstammen. Die Verhältnisse sind also genau wie bei den Crocodilen[1]).

Hiermit ist wie mir scheint endgültig entschieden, dass der Wirbel *α* der letzte Lumbarwirbel ist.

[1]) Manchmal fehlt bei den Vögeln die letzte obturatorius-Wurzel.

Der folgende Wirbel, also der erste Wirbel des II. Abschnittes, 1_{II}, ist somit der erste echte Sacralwirbel, dem ersten der beiden Sacralwirbel der Crocodile entsprechend. Bei den Crocodilen wird der *Plexus ischiadicus* von drei Wurzeln gebildet, die resp. vor dem ersten Sacralwirbel, zwischen den beiden Sacralwirbeln und hinter dem zweiten Sacralwirbel heraustreten. Bei den Vögeln hat sich jedoch eine grössere Anzahl Wurzeln entwickelt, nämlich 4—7, die grösstenteils aus folgenden Nervenöffnungen heraustreten: denen zwischen den Wirbeln des II. Abschnittes und der vor dem ersten und der hinter dem letzten Wirbel dieses Abschnittes; endlich bei einigen (aber keineswegs immer) auch aus der Nervenöffnung zwischen den Wirbeln *a* und *b*, selten auch aus der zwischen *b* und *c*.

Ob wir nun die sämtlichen Wirbel, vor und hinter denen Ischiadicus-Wurzeln austreten, zusammen als den zwei Sacralwirbeln des Crocodile homolog betrachten sollen, also eine stärkere Gliederung[1]) des Sacralwirbelabschnittes der Reptilien annehmen sollen, oder ob wir nur die zwei ersten Wirbel des II. Abschnittes der Vögel als den Sacralwirbeln der Reptilien entsprechend und die übrigen oben genannten Wirbel als herangezogene Caudalwirbel deuten sollen, ist schwierig zu sagen. Möglich wäre es auch, dass sowohl eine stärkere Gliederung des ursprünglichen Sacralabschnittes und noch dazu eine Heranziehung von einigen Caudalwirbeln stattgefunden hat. Vielleicht sind sämtliche Wirbel des II. Abschnittes durch jene stärkere Gliederung aus dem Sacralabschnitte entstanden, und die Wirbel des III. Abschnittes herangezogene Caudalwirbel. Für die Entscheidung der angeregten Fragen dürfte noch folgendes von Interesse sein:

Bei den Crocodilen werden die Querfortsätze der beiden Sacralwirbel und der vier ersten Caudalwirbel von je einer besonderen Verknöcherung gebildet, die, nach meinem Dafürhalten ohne genügenden Grund, als Rippen aufgefasst wurden; ob wir dies annehmen oder nicht, ist übrigens für unsere hiesigen Betrachtungen ohne Belang. An mehreren vorliegenden Beckenpräparaten (Tab. 3, Fig. 3) von jungen Hühnchen zeigt es sich, dass die Querfortsätze der Wirbel des II. und des III. Abschnittes, sowohl des dorsalen wie des ventralen Astes des letzteren, eine besondere Verknöcherung enthalten, die durch eine Knorpelscheibe von dem übrigen Wirbel getrennt ist, jedenfalls habe ich mit Sicherheit eine solche separate Verknöcherung an sämtlichen Wirbeln des II. Abschnittes mit Ausnahme des ersten, dessen Querfortsatz sehr kurz ist, und an den Wirbeln *a* und *b* gefunden[2]).

Die betreffenden Wirbel des Hühnchens verhalten sich also in Bezug auf die Verknöcherung ihrer Querfortsätze wie die echten Sacralwirbel und die ersten Cau-

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[1] Vergl. oben p. 6.

[2]) Gegenbaur (l. c. p. 206—7) hat sich ebenfalls mit den genannten Separat-Verknöcherungen beschäftigt, hat aber nicht genügend junge Stadien gehabt, und ist dadurch zu dem Resultat gelangt, dass nur die ventralen Äste der Querfortsätze der Wirbel *a* und *b* (seine echten Sacralwirbel) einer selbständigen Verknöcherung entstammten, während die dorsalen »vom Wirbelbogen ossificiren« sollten; auch hat er keine der Ossificationen der Querfortsätze des II. Abschnittes gesehen.

dalwirbel der Crocodile. Die Befunde entscheiden somit nicht, ob die uns interessierenden Wirbel der Vögel alle einen stärker gegliederten Sacral-Abschnitt repräsentieren oder ob sie teils Sacralwirbel, teils herangezogene Caudalwirbel sind, nach den Befunden ist beides möglich; am meisten neige ich zu der Anschauung[1]), dass sämtliche Wirbel des II. Abschnittes, die so sehr mit einander übereinstimmen, den stärker gegliederten Sacralwirbel-Abschnitt repräsentieren, während die Wirbel *a* und *b*, die nicht immer mit dem Plexus in Beziehung stehen, Caudalwirbel sind; sie schliessen sich ja auch morphologisch eng an die folgenden Wirbel an, die zweifellose Caudalwirbel sind[2]).

Unter allen Umständen sind die beiden ersten Wirbel des II. Abschnittes echte Sacralwirbel. Es ist natürlich einigermassen überraschend, dass diese Wirbel bei den Vögeln meistens sehr wenig zum Tragen des Beckens beitragen, während bei den Reptilien die Sacralwirbel die eigentlichen Träger des Beckens sind. Das stammt daher, dass andere Wirbel diese Aufgabe übernommen haben, besonders die des I. Abschnittes. Bei manchen Vögeln kann aber wenigstens der erste von unseren echten Sacralwirbeln einen Ventralast besitzen, der in einzelnen Fällen sehr stark sein und der Wirbel somit etwas mehr zum Tragen des Beckens beitragen kann.

Die hier vertretene Auffassung bezüglich der primären Sacralwirbel fällt, wie schon oben bemerkt, nicht mit der von Gegenbaur vorgetragenen zusammen.

In seiner Abhandlung über das Vogelbecken hebt Gegenbaur unter dem Abschnitt »II. Vergleichung« p. 194—95 hervor, dass »in fast allen Abtheilungen zwei Wirbel [*a* und *b* unserer und seiner Figuren] bestehen, welche durch manche Eigenthümlichkeiten sich auszeichneten, vor Allem aber im Verhalten ihrer doppelten Querfortsätze zum acetabularen Theile des Iliums als constante Gebilde erscheinen«. Die hervorragende physiologische Bedeutung der Querfortsätze dieser Wirbel, die vorläufig wegen ihrer Lage als Acetabularwirbel bezeichnet werden, wird hervorgehoben, er weist aber mit Recht dies als für die morphologische Entscheidung unmassgebend zurück, dagegen findet er eine Stütze für die Auffassung derselben als die primären Sacralwirbel in einer vermeintlich relativ starken Ausbildung der Querfortsätze derselben bei jugendlichen Tieren, was mir nicht aufgefallen ist. Auf dieser wie mir scheint etwas schwachen Basis meint Gegenbaur »diesen Wirbeln eine phylogenetische Bedeutung zuschreiben zu dürfen. Sie erscheinen als Homologa von zwei Wirbeln, welche in

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[1]) Vergl. die unten p. 13 zitierte Auffassung von Huxley.

[2]) Wie allgemein die separate Verknöcherung der Querfortsätze des II. Abschnittes und der dorsalen Äste der Querfortsätze der III. Abschnittes bei den Vögeln verbreitet ist (den ventralen Querfortsatz wenigstens des Wirbels *a* habe ich allgemein durch eine separate Verknöcherung vertreten gefunden), kann ich nicht sagen. Bei einigen untersuchten jungen Vögeln fand ich keine Spur davon; das kann aber daher stammen, dass die betreffenden Exemplare entweder zu jung oder zu alt waren. Bei einem jungen *Limosa aegocephala* habe ich dagegen eine deutliche Separat-Verknöcherung des Querfortsatzes am letzten Wirbel des II. Abschnittes und an den dorsalen Ästen der Querfortsätze von *a* und *b* gefunden. Auch bei einem jungen *Crypturus obsoletus* fand ich deutliche Spuren einer Trennungslinie an dem Querfortsatz des letzten Wirbels von II und and dem dorsalen Ast von *a*. Es ist nach diesen Beispielen offenbar, dass eine Separatverknöcherung der beregten Fortsätze nicht auf eine geringe Anzahl von Vögeln beschränkt ist; möglich ist es aber dass dieselbe bei manchen verloren gegangen ist.

der nächst unteren Abtheilung die einzigen Sacralwirbel sind«. Und er fügt hinzu (p. 196): »Wenn nun diese beiden Wirbel ererbte typische Sacralwirbel sind, zu denen die vor und hinter ihnen liegende sich als accessorische Sacralwirbel verhalten, so muss auch in dem Verhalten der bezüglichen S p i n a l n e r v e n [hervorgehoben von mir] eine übereinstimmende Einrichtung zu finden sein«. Bei der Untersuchung des Lumbosacralplexus ist Gegenbaur aber nicht über die Verhältnisse an der Grenze des Crural- und des Ischiadicus-Plexus klar geworden, indem er auf die abweichende Form des Plexus getroffen hat, die durch das Vorhandensein einer Extrawurzel des Ischiadicus-Plexus (*Oi*, vergl. unten p. 21) charakterisiert ist und dieselbe als die typische auffasst[1]), dabei aber auch noch andere Nervenverhältnisse gesehen hat, gibt er es auf diesen Teil des Plexus für die Homologisierung zu verwenden, wendet sich dagegen an die letzte Ischiadicus-Wurzel, die nach ihm »stets zwischen jenen beiden Wirbeln austritt«. Es ist nicht richtig, dass sie »stets« sich derartig verhält; ich fand es so unter den von mir untersuchten bei Phoenicopterus, bei Anas crecca, bei einem Cygnus, einer Ardea, Ciconia, einem Scolopax gallinago; in anderen Fällen trat die letzte Ischiadicus-Wurzel aber v o r dem vordersten der genannten Wirbel (*a*) hervor, nämlich bei Corvus, Buteo, Tetrao urogallus, Gallus domesticus; in anderen Fallen wieder h i n t e r dem hintersten Wirbel (*b*), nämlich bei einer Ardea, mehreren Cygnus, einem Scolopax gallinago. Auffallend ist, dass Gegenbaur das Huhn als Beispiel anführt, da ich bei den zahlreichen Exemplaren dieser Vogels, die ich untersucht habe, stets den Austritt v o r *a* gefunden habe.

Die vermeintliche Konstanz der Lage dieses Nervs zwischen *a* und *b* bei den Vögeln vergleicht er weiter mit dem Verhalten der letzten Ischiadicus-Wurzel bei den E i d e c h s e n, bei denen sie zwischen den beiden Sacralwirbeln austreten soll. Nach den Figuren von Mivart & Clarke (l. c.) ist diese Angabe aber nicht richtig: die letzte Wurzel tritt bei den Eidechsen h i n t e r dem letzten Sacralwirbel heraus. So viel von der Begründung der Gegenbaur'schen Anschauung. Mein grosser Lehrer ist hier nicht gerade glücklich gewesen.

Richtiger als G. hat Huxley in seinem Manual of the Anatomy of Vertebrated Animals (1871) p. 238—39 die Homologien beurteilt. »The most anterior lumbar vertebra has a broad transverse process, which corresponds in form and position with the tubercular transverse process of the last dorsal. In the succeeding lumbar vertebræ this process extends downward; and in the hindermost [unser *a*], it is continued from the centrum, as well as from the arch of the vertebra, and forms a broad mass which abuts against the ilium. This process might well be taken for a sacral rib, and its vertebra for the proper sacral vertebra. But, in the first place, I find no distinct ossification in it; and, secondly, the nerves which issue from the intervertebral foramina in front and behind this vertebra enter into the lumbar plexus, which gives origin to the crural and obturator nerves, and not into the sacral plexus[2]), which is the product of the nerves which issue from the intervertebral foramina of the proper sacral vertebræ in other *Vertebrata*. Behind the last lumbar vertebra follow, at most, five vertebræ [unser II. Abschnitt] which have no ribs, but their arches give off horizontal, lamellar, transverse processes, which unite with the ilia. The nerves which issue from the intervertebral foramina of the vertebræ unite to form the sacral plexus, whence the great sciatic nerve is given off; and I take them to be the homologues of the sacral vertebræ of Reptilia«. Wie sich Huxley das Verhältnis der von ihm als Sacralwirbel der Vögel bezeich-

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[1]) Die von Gegenbaur p. 201 gegebene schematische Figur (Fig. 1) des Lumbo-Sacral-Plexus der Vögel stellt in der Tat nicht das typische Verhältniss desselben bei den Vögeln dar, sondern einen Fall wo *Oi* vorhanden ist, er ist ähnlich dem von mir Tab. 12 Fig. 5 abgebildeten einer Ardea. Der an der Figur Gegenbaurs mit *4* bezeichnete Wirbel ist unser Wirbel *a* und der den Querfortsatz desselben kreuzende Nerv ist *Oi*, während *1c* fehlt.

[2]) Das ist übrigens nicht ganz richtig, denn die erste Wurzel des Plexus ischiadicus oder sacralis kommt eben hinter »this vertebra« hervor.

neten Wirbel zu den zwei Sacralwirbeln der Reptilien gedacht hat, ist nicht aus diesen Äusserungen klar. Er ist aber insofern auf dem richtigen Wege gewesen als er die Sacralwirbel der Vögel in unserem II. Abschnitt gesucht hat.

Auch bereits in seiner berühmten Arbeit On the Classification of Birds[1]) hat er sich in der Einleitung (die Arbeit beschäftigt sich ja hauptsächlich mit dem Schädel) mit den Sacralwirbeln beschäftigt und zwar in den folgenden Worten: »Although all birds possess a remarkably large sacrum, the vertebræ, through the intervertebral foramina of which the root of the sacral plexus (and, consequently, of the great sciatic nerve) pass, are not provided with expanding ribs abutting against the ilium externally, and against the bodies of these vertebræ by their inner ends. In recent reptiles possessing well-developed hind limbs, the intervertebral foramina through which the roots of the sciatic nerve pass, are wholly, or in part, bounded by vertebræ provided with thick and expanded ribs; and these ribs are connected, more or less extensively, on the one hand, with the bodies of these vertebræ, and on the other with the iliac bones. The vertebræ in question, of which there are ordinarily two, constitute the sacrum. In Birds the arches of the vertebræ which correspond with these in their relation to the nerves (and therefore must also be termed »sacral«) give off comparatively slender transverse processes, which seem to answer to those which unite with the tubercle of the ribs in the dorsal region; and it is by these transverse processes only that they are connected with the ilia«. Diese Bemerkungen hat Gegenbaur in seiner Abhandlung zitiert (p. 99—100) und hat sie folgendermassen kritisiert: »Huxley deutet also den der vorderen [d. h. ventralen] Querfortsatzschenkel entbehrenden Sacralabschnitt [unseren II. Abschnitt] als Sacrum, statuirt also, da dieser Abschnitt mehr als zwei Wirbel begreift, eine Verschiedenheit gegen das Sacrum der lebenden Reptilien. Die Voraussetzung eines phylogenetischen Zusammenhangs zwingt aber wenigstens zum Versuche, die in den unteren Abtheilungen bestehenden und dort verbreiteten Sacralwirbel aufzudecken und dann nachzuweisen, welche Wirbel zu diesen hinzutretend die Zahl der Sacralwirbel erhöhen.«

c. Die einzelnen Abschnitte des Kreuzbeins.

Die Zahl der Wirbel des I. Abschnittes schwankt zwischen 3 und 8. Von diesen Wirbeln sind meistens 1—2, seltener 3, noch seltener 4 (Pelecanus, Anas acuta, Cygnus), ganz selten 5 (Cygnus) rippentragend; nur in einzelnen Fällen fand ich gar keinen Wirbel rippentragend (ein Gallus dom., eine Fringilla canaria, ein Crypturus tataupa). Der letzten Rippe fehlt sehr allgemein das Collum, indem sie nur mit dem Querfortsatz verbunden ist; dasselbe kann auch mit der vorletzten Rippe der Fall sein (Sómateria, Sarcorhamphus), ganz selten mit der drittletzten (Cygnus). Die letzte Rippe ist manchmal festgewachsen, selten ist das auch mit der vorletzten der Fall (Cygnus).

Die Dornfortsätze des I. Abschnittes, die meist recht wohlentwickelt, sind beim ausgebildeten Vogel zu einem einheitlichen Kamm verschmolzen, der sich auch in den niedrigeren Kamm des folgenden Abschnittes fortsetzt. Die Querfortsätze (Tab. 1, Fig. 1—3; Tab. 2, Fig. 1) sind recht kurz aber stark und mit ihrem erweiterten Ende mit der Innenseite (Unterseite) des vorderen Teils des Ilium verbunden; diese auf einander folgenden peripheren Enden können beim erwachsenen Tier sehr häufig mit einander verwachsen. Der Ursprung der Querfortsätze ist an den vordersten Wirbeln hoch oben, dehnt sich aber an den folgenden allmählich weiter ventrad, so

[1]) On the Classifications of Birds, etc. in: Proceed. Zool. Soc. 1867 p. 416—17.

weit dass die Unterseite des letzten Querfortsatzes dieses Abschnittes in demselben Niveau wie die platte Unterseite derselben Wirbelkörpers liegt, indem die Querfortsätze gleichzeitig mehr von vorn nach hinten abgeplattet werden. Der letzte Querfortsatz wird dabei noch allgemein von einem grossen Loch durchbohrt, das den Fortsatz in einen dorsalen und einen ventralen Ast teilt, die an der Basis zusammenhängen, während die peripheren an das Ilium sich heftenden Enden meistens getrennt sind. Manchmal ist auch der Querfortsatz des vorletzten Wirbels (β) in derselben Weise ausgebildet; bei ihm hängen aber die distalen Enden meist zusammen, oder die beiden Äste sind durch eine dünne Knochenplatte verbunden.

Die beschriebenen Wirbel des I. Abschn. werden alle von dem Ilium überdeckt und sind mit ihm verbunden. Bei *Pelecanus* findet man die Eigentümlichkeit, dass vor dem vordersten unterhalb des Ilium gelegenen Wirbel noch 2 oder 3 Wirbel sich finden die mit dem betreffenden Wirbel und mit einander verwachsen sind und die also nicht von dem Ilium überdeckt sind. Bei *Graculus* (2 Exempl.), bei *Plotus*, *Sula* (2 Ex.), bei einem *Cypselus* (Tab. 3, Fig. 8) u. a. habe ich einen solchen festgewachsenen Wirbel gefunden, der vor dem Ilium liegt. — Bei anderen Vögeln kann man bisweilen umgekehrt finden, dass der letzte freie Wirbel vor dem Kreuzbein, besonders dessen Querfortsätze, unter dem vordersten Ende des Ilium Platz haben, also ohne mit dem Ilium verwachsen zu sein.

Der II. Abschnitt (Tab. 1, Fig. 4—5) besteht meist aus 3—5 Wirbeln, seltener aus nur 2, ganz selten aus 6 Wirbeln. Dieser Abschnitt ist sehr von dem vorhergehenden verschieden. Die Querfortsätze desselben werden allmählich nach hinten zu länger, der vorderste ist nicht länger als die des I. Abschn. Sie entspringen hoch oben von dem Bogen, höher oben als die Nervenöffnungen und setzen sich an ihrer Basis ventrad auf dem Wirbel höchstens mit einer ganz niedrigen Kante (oder gar nicht) fort. Ihre nicht oder wenig erweiterten Enden heften sich an den Rand des Ilium. Sie sind im Ganzen recht schwach. An dem vordersten dieser Wirbel kann manchmal, wenn auch allerdings ausnahmsweise, die Ausbildung eines Ventralastes (Tab. 5, Fig. 3, 7—9; Tab. 6 passim; etc.) stattfinden; ich führe davon die folgenden Beispiele an: An einem Exemplar von Sarcorhamphus gryphus hat sich auf der linken Seite ein schwacher dünner Ventralast ausgebildet, der sich der Innenseite des Ilium anheftet; auf der rechten Seite ist derselbe Ast vorhanden, ist aber nur teilweise verknöchert. Den Ventralast habe ich ähnlich, aber nur einerseits, bei einem Falco gyrfalco gefunden, beiderseits bei einem F. tinnunculus. Ein haarfeines Rudiment des Astes finde ich bei einem Exemplar von Grus cinerea. Bei einem Hahn ist derselbe Ast beiderseits recht kraftig entwickelt und dem des Wirbels α sehr ähnlich, wenn auch kenntlich schwächer. Noch stärker finde ich den Ast bei einem Bubo, links am stärksten. In einem solchen Fall kann es zweifelhaft sein ob der betreffende Wirbel dem I. oder dem II. Abschnitt angehört; durch Heranziehung der Nerven lässt es sich jedoch unschwer entscheiden. — Andere Beispiele von einer Ausbildung des genannten Ventralastes liefern mehrere unsere Figuren.

Auch an dem letzten Wirbel des II. Abschnittes kann nicht ganz selten ein Ventralast als individuelle Variation ausgebildet sein. Meistens ist derselbe ein drahtdünner Knochenstab, wie bei dem Tab. 4, Fig. 4 abgebildeten Präp. von einem Storch, kann aber auch stärker werden und sich an Stärke dem des nachfolgenden Wirbels *a* (des III. Abschn.) nähern wie bei dem Präp. eines anderen Storchs (Tab. 4, Fig. 6). Ausser bei den genannten Störchen habe ich noch diesen Ventralast bei verschiedenen anderen Vögeln gefunden. Ich führe folgende an: Bei einem Schwarzen Schwan ist der betreffende Wirbel auf der rechten Seite mit einem haardünnen ventralen Ast versehen; der Ast hat eine kurze Unterbrechung, wo er wohl bindegewebig gewesen ist; links ist keine Spur eines Ventralastes vorhanden. Bei einem Leptoptilus sind beiderseits Spuren eines Ventralastes vorhanden, von denen aber nur die beiden Enden knöchern entwickelt sind, und auch noch bei anderen habe ich ähnliche Spuren gefunden. Bei einer Ente (Tab. 5, Fig. 9) ist dagegen der Ventralast beiderseits so stark ausgebildet, dass er stärker ist als an dem Wirbel *b*, wenn auch schwächer als an dem Wirbel *a*, und ähnlich verhält sich auch ein Hühnchen, jedenfalls auf der einen Seite (die andere Seite des Wirbels ist beschädigt). Sehr eigenartig verhält sich ein Exemplar von Crypturus obsoletus (Tab. 4, Fig. 8), bei dem auf der linken Seite des betreffenden Wirbels ein Ventralast ausgebildet ist, der ebenso stark ist wie der Ventralast von *a*; dabei ist aber zu bemerken dass an *a* nur rechts ein Ventralast vorhanden ist, an dem Wirbel des II. Abschnittes dagegen kein Ventralast rechts.

Wenn die Entwicklung des Ventralastes an dem letzten Wirbel des II. Abschnittes stark ist, kann man daran unsicher sein, ob der fragliche Wirbel dem II. Abschnitt angehört oder ob er eher als der Wirbel *a* des III. Abschnittes aufzufassen ist. Wir bemerken noch, dass das periphere Ende des Ventralastes häufig mit dem Ende des Ventralastes von *a* verwächst. Man hat in solchen Fällen eigentlich den Eindruck, dass der Wirbel einen Übergang zu dem folgenden Abschnitt bildet.

Die von uns als der III. Abschnitt gesonderte Partie sind die von Gegenbaur mit den Buchstaben *a* und *b* bezeichneten Wirbel (Tab. 1, Fig. 7, 10—12, Tab. 4, Tab. 5, Tab. 6). Sie sind besonders durch die Ausbildung der Querfortsätze charakterisiert. Der Querfortsatz von *a* ist gewöhnlich der längste sämtlicher Kreuzbeinwirbel; er ist in einen dorsalen und einen ventralen Ast gespalten; der Ursprung des ventralen Astes ist derart dass er ungefähr in demselben Niveau mit der Unterseite des Wirbelkörpers liegt; der Ast kann in seinem weiteren Verlauf entweder horizontal liegen oder etwas schräg dorsad gerichtet sein; allgemein sind der dorsale und der ventrale Ast an ihrem peripheren Ende mit einander verwachsen. Der Querfortsatz von *b* kann dem von *a* ähnlich sein, ist aber durchweg schwächer und nicht so weit ventral gelegen; durch ein grösseres oder kleineres Loch — das aber auch fehlen kann — ist er in einen dorsalen und einen ventralen Ast geteilt; das periphere Ende des Querfortsatzes ist allgemein mit dem von *a* verwachsen. Bei manchen Vögeln ist nur der Querforsatz von *a* in der beschriebenen Weise ausgebildet, während der von *b* völlig wie der des folgenden Wirbels sich verhält. Solches ist z. B. bei *Graculus* der Fall; bei *Larus* und bei *Sula* ist der Querfortsatz von *b* sogar noch weniger hervortretend als die der folgenden Wirbel. Andererseits kann man ausnahmsweise finden, dass der Querfortsatz von *b* sehr stark ist, stärker als der von *a*, wie ich es bei ein paar Gänsen

u. a. gefunden habe; bei einem Porphyrio ist der Ventralast von *a* links etwas schwächer als der von *b*, rechts ist er haarfein, der von *b* dagegen sehr stark. — Bei nicht wenigen Vögeln, z. B. bei manchen Oscines (Tab. 5, Fig. 3; Tab. 7, Fig. 5—6), sind die Querfortsätze der Wirbel *a* und *b* beide sehr wenig vor denen der vorhergehenden und folgenden ausgezeichnet; das kann so weit gehen, dass es schwierig ist zu entscheiden, welche der Wirbel als *a* und *b* aufzufassen sind.

Die Wirbel des IV. Abschnittes, besonders auch deren Querfortsätze, schliessen sich derartig eng in ihrer Ausbildung an die des III. Abschnittes, dass es sehr natürlich fallen würde unseren III. und IV. Abschnitt zu einem zu vereinigen; wenn ich sie getrennt halte, geschieht das unter anderem aus praktischen Gründen. Am natürlichsten fällt eine Vereinigung bei solchen Formen, bei denen die Wirbel *a* und *b* sich wenig von den folgenden unterscheiden.

Der Querfortsatz des ersten Wirbels des IV. Abschnittes — wir bezeichnen denselben als *c* — ist meist ein wenig kürzer als der von *b*, ist meistens auch nicht durchbohrt (kann es aber sein: z. B. bei Pelecanus), ist aber im übrigen diesem ähnlich, liegt jedoch etwas weniger ventral. Ähnlich verhält sich auch der folgende (oder mehrere folgende), der noch etwas kürzer sein kann. Die letzten 1—3 Querfortsätze (Tab. 1, Fig. 8) verhalten sich aber wieder anders: die betreffenden Wirbel können mehr abgeplattet sein, und ihre Querfortsätze liegen derart, dass ihre ventrale Fläche im Niveau der Unterseite des betreffenden Wirbelkörpers liegt; das periphere Ende dieser Querfortsätze ist erweitert zur Verbindung mit dem Ende der Crista iliaca post., während die Enden der vorhergehenden Wirbel des IV. Abschnittes schmal sind zwecks Verbindung mit dem dünnen Ilium-Rande. Die letzten Querfortsätze sind auch allgemein mehr quer gerichtet als die vorhergehenden, die meist eine Richtung mehr caudad haben. — Sehr eigentümlich ist die Ausbildung der letzten Querfortsätze bei den Ralliden (Tab. 7, Fig. 2; Tab. 2, Fig. 9). Hier ist die mediane Seite des Recessus iliacus (Tab. 2, Fig. 10) sozusagen abgeschnitten, so dass zwei Ränder entstanden sind, einer dem Ilium selbst, der andere der Crista iliaca post. angehörig, die caudal in einander übergehen, und in Anpassung hieran sind die Querfortsätze in je zwei weit getrennte Äste (*e*, *e*, *f*, *f*) gespalten, von denen die Enden der dorsalen Äste sich mit dem Ilium-Rand verbinden, die Enden der ventralen Äste mit dem Crista-Rand.

Die Zahl der Wirbel des IV. Abschnittes ist verschieden; meist ist die Zahl 3—7, bei manchen Raubvögeln und auch bei etlichen Oscines, Clamatores und Alciden kann die Zahl auf 2 sinken, andererseits kann die Zahl bei Cygnus auf 8 oder 9, bei den Ratiten sogar auf 10 steigen.

Manchmal ist der Querfortsatz des letzten angewachsenen Kreuzbeinwirbels mit seinem peripheren Ende nicht mit dem Ilium-Rand verbunden (Sula, Crax, Phoenicopterus, Dicholophus) oder nur teilweise (Sarcorhamphus). Andererseits kann man finden, dass der letzte Wirbel, dessen Querfortsatz sich mit dem Ilium verbindet, frei ist, also nicht dem »Kreuzbein« angehört (derartig fand ich es z. B. bei einer Gans).

2. Plexus lumbosacralis.

Wir haben uns bereits oben (p. 9—11) mit dem Plexus lumbosacralis etwas beschäftigt; hier soll wegen der Bedeutung des Plexus für die Homologisierung der

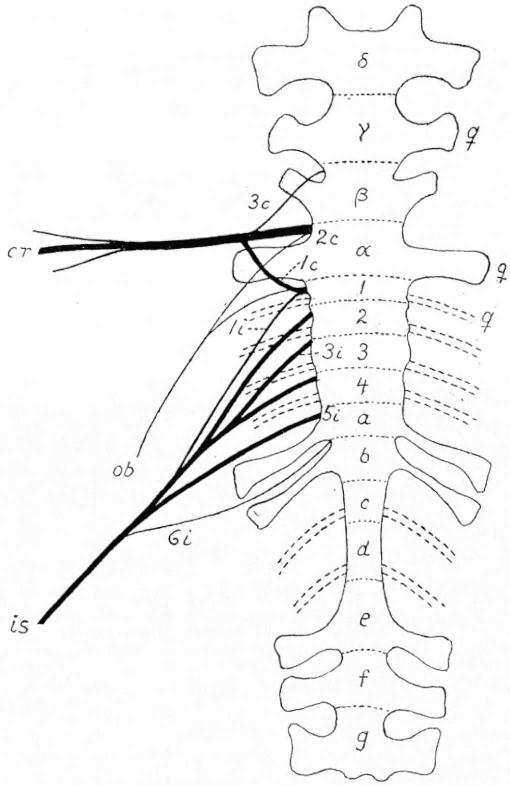

Fig. 4. Schema des typischen Verhältnisses des Lumbo-Sacralplexus der Vögel *α—δ* Wirbel des I. Abschnittes. 1—4 Wirbel des II. Abschn. *a—b* III. Abschnitt. *c—g* IV. Abschnitt. *1c—3c* die drei Wurzeln des Cruralplexus. *cr* Nervus cruralis. *1i—6i* die Wurzeln des Plexus ischiadicus. *is* Nervus ischiadicus. *ob* N. obturatorius. *q* Querfortsätze.

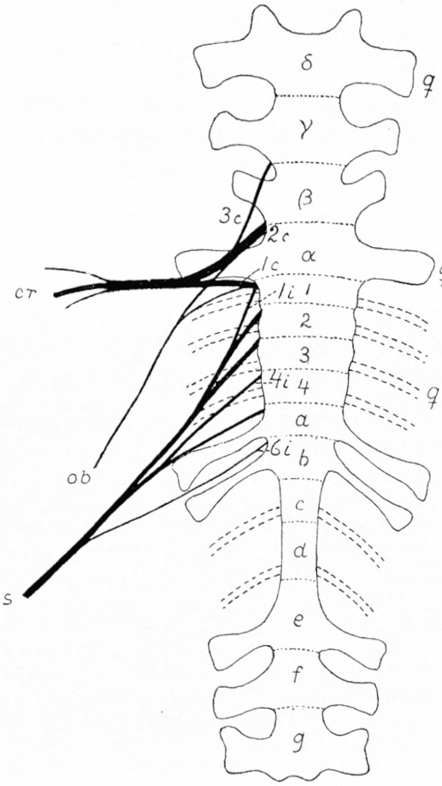

Fig. 5. Dasselbe wie Fig. 4. Die Wurzel *1c* verläuft aber hinter dem Querfortsatz, von *α*, kreuzt ihn nicht wie in Fig. 4; dagegen kreuzt *2c* denselben Querfortsatz, was in Fig. 4 nicht der Fall ist. Auch andere kleine Unterschiede sieht man.

Kreuzbein-Elemente auf denselben näher eingegangen werden, besonders auf die recht merkwürdigen individuellen Variationen, denen er unterworfen ist.

Der durch die ganze Vogelklasse hindurch herrschende Typus des Plexus ist sehr fest; es ist der folgende:

Von den zwei Abschnitten, in welche der Plexus wie bei anderen Wirbeltieren zerfällt, wird der erste, der *Plexus cruralis,* aus drei oder vier Wurzeln gebildet, von denen der letzte aus der Nervenöffnung hinter dem letzten Lumbarwirbel, *α*, heraustritt, die übrigen hinter den vorhergehenden Wirbeln, β und γ, resp., wenn vier Wurzeln vorhanden sind, aus den Nervenöffnungen hinter β, γ und δ. Die letzte Cruralis-Wurzel verläuft allgemein laterad hinter dem Querfortsatz von α (Textfig. 5), kann aber auch von ihrem Ursprung hinter der Basis des Querfortsatzes manchmal schräg kopfwärts querüber den Querfortsatz verlaufen (Textfig. 4) um sich mit den anderen zu verbinden. Aus dem Zusammenfluss der Wurzeln spaltet sich ein Fächer von Nerven aus, die in querem Verlauf zu der Hintergliedmasse gehen, und ein besonders hervortretender caudad verlaufender Nerv, der *N. obturatorius*, der mit 2 (selten 3) Wurzeln entsteht, von denen die hinterste sich entweder aus der letzten Cruralis-Wurzel oder aus der vorletzten abzweigt.

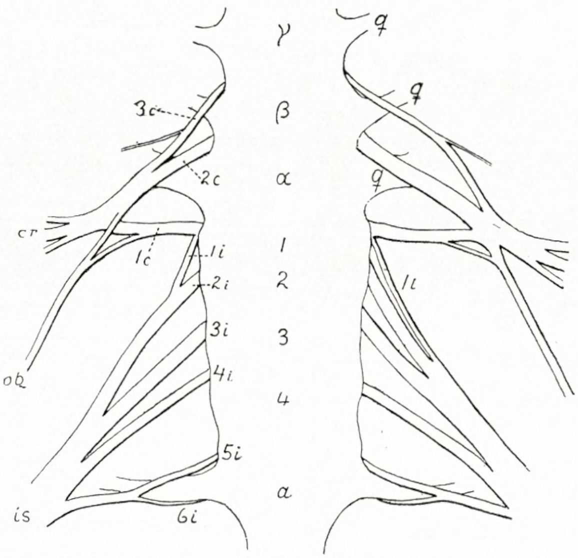

Fig. 6. Lumbo-Sacralplexus von *Vanellus cristatus*, nicht schematisiert. Entspricht völlig der Fig. 5. Die Bezeichnungen dieselben.

Der zweite Abschnitt, der *Plexus ischiadicus*, wird durch den Zusammenfluss von meist 6 (seltener 4, 5 oder 7) Wurzeln gebildet, von denen die erste mit der letzten Cruralis-Wurzel zusammen aus dem Nervenloch hinter dem Wirbel α heraustritt, während die übrigen aus den Nervenlöchern des II. Abschnittes, resp. aus den ersten nach diesen folgenden Nervenöffnungen heraustreten. Die letzte Wurzel, die häufig sehr dünn ist, entspringt meist entweder der Nervenöffnung vor a (Tab. 10, Fig. 2 etc., Tab. 9, Fig. 3—5) oder der zwischen a und b (Textfig. 4 etc.), selten der Nervenöffnung hinter b (Exemplare von Cygnus (Tab. 13, Fig. 1—2), Ardea (Tab. 12, Fig. 4—5)); mit ihr zusammen entspringt die erste Wurzel des *Plexus pudendus*, in der Regel von der Ischiadicus-Wurzel bis an die Nervenöffnung getrennt; manchmal kann die Pudendus-Wurzel jedoch eine Strecke weit mit der Ischiadicus-Wurzel verbunden sein (z. B. Ardea, Tab. 12, Corvus frugilegus, Tab. 11, Fig. 4, Totanus, Tab. 14, Fig. 3). Von den anderen Wurzeln ist die erste manchmal schwächer als die folgenden.

Derartig wie beschrieben habe ich die Verhältnisse des Lumbosacralplexus durchweg bei Repräsentanten sämtlicher von mir untersuchten Vogel-Ordnungen gefunden: Ratiten, Tinamiden, Hühnervögel, Schwimmvögel, Watvögel, Raubvögel, Oscines, Scansores. Das Schema liegt überall fest.

Daneben habe ich aber, besonders an der Grenze der beiden Plexus-Abschnitte diverse Eigenarten gefunden, die sich meist als individuelle herausgestellt haben, d. h. wenn ich bei einem Vogel etwas Eigenartiges gefunden habe, hat es sich bei Untersuchung mehrerer Exemplare derselben Vogelart ergeben, dass die Eigenart

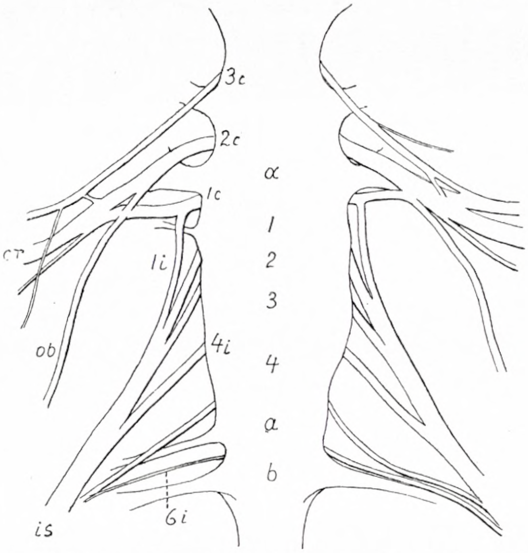

Fig. 7. Plexus lumbosacralis von *Limosa aegocephala*. *1c* und *1i* mit kurzem gemeinsamen Ursprungsstamm. Am Wirbel 1_{II} rechts ein Ventralast. Am Wirbel *a* nur rechts ein Ventralast.

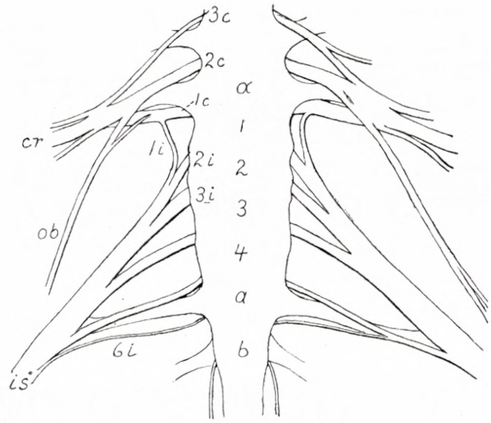

Fig. 8. Plexus lumbosacralis von *Limosa lapponica*. Etwas eigenartiger Ursprung der *1i* (nicht so bei einem anderen Exemplar, wo er ganz typisch war).

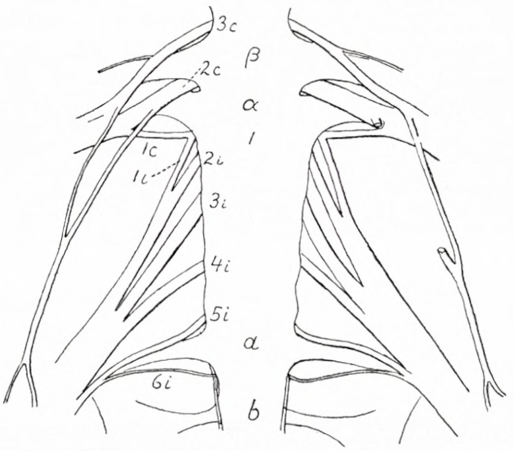

Fig. 9. Plexus lumbosacralis von *Scolopax rusticola*. Ganz typisch.

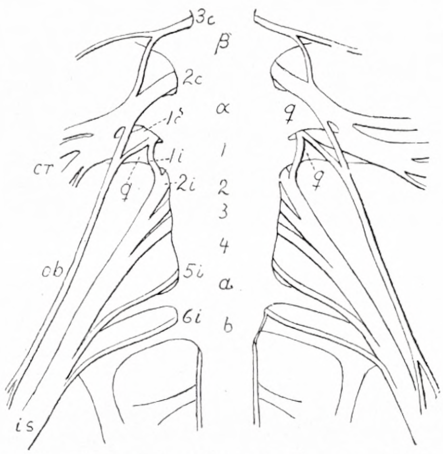

Fig. 10. *Plexus lumbosacralis* von *Scolopax rusticola*. Typisch. Am Wirbel 1_{II} jederseits ein Ventralast, *q*.

nicht allen Exemplaren der Art angehörte, sondern nur einigen. Und manches, was zunächst als etwas von der Regel Abweichendes imponierte, hat sich bei näherer Untersuchung und Überlegung als etwas innerhalb der Regel Befindliches herausgestellt.

Gehen wir die wirklichen und scheinbaren Abweichungen, die gefunden wurden, der Reihe nach durch.

Bei *Picus viridis* (ich habe von dieser Art drei Exemplare untersucht, die sich in der Hauptsache gleich verhielten) Tab. 11, Fig. 1, wird der Cruralplexus aus drei Wurzeln gebildet, von denen die letzte aus der Nervenöffnung hinter dem letzten, hier sehr starken, Lumbar-Querfortsatz heraustritt, also die typischen Verhältnisse. Diese letzte Wurzel kreuzt sich aber in ihrem Verlauf querüber den Querfortsatz mit einem Ast (*0i*) von der vorletzten Cruralis-Wurzel (*2c*), der zu dem Ischiadicus-Plexus geht und sich mit der normierten ersten Ischiadicus-Wurzel verbindet, die aus demselben Nervenloch wie die letzte Cruralis-Wurzel heraustritt. Wir haben hier also mit einer überzähligen Ischiadicus-Wurzel zu tun, die weiter kopfwärts als die anderen entspringt. An der Kreuzungsstelle kann dieselbe (vergl. die Figur rechts) mit der Cruralis-Wurzel verwachsen sein, so dass beide zusammen ein X bilden. Ausser der überzähligen Ischiadicus-Wurzel (*0i*) finden sich noch 5 Ischiadicus-Wurzeln, von denen die drei ersten (*1i*, *2i*, *3i*) stark sind, während die vierte (*4i*) schwächer und die fünfte ganz dünn ist. — Bei zwei untersuchten Exemplaren von *Picus major* (Tab. 11, Fig. 2) fehlt die letzte Cruralis-Wurzel (*1c*), während dagegen die überzählige Ischiadicus-Wurzel (*0i*) vorhanden ist. Dieselben weichen auch dadurch von dem Picus viridis ab, dass nur noch die Ischiadicus-Wurzeln *1—4 i* vorhanden sind.

Ähnliche Verhältnisse wie bei Picus habe ich auch bei den Corviden (Corvus frugilegus, C. cornix, Pica caudata) gefunden. Hier ist stets die überzählige Ischiadicus-Wurzel (*0i*) vorhanden, bei einigen Exemplaren in Kreuzung mit der Cruralis-Wurzel *1c*, die aber auch — vergl. Picus major — auf der einen oder auf beiden Seiten fehlen kann. Die Figuren-Reihe Tab. 11, Fig. 3—7, illustriert dies sehr schön. In der Fig. 3 sieht man beiderseits die Xformige Kreuzung (vergl. Textfigg. 11—12). In der Fig. 4 ist dasselbe auf der linken Körperseite (rechts in der Figur) der Fall, auf der rechten Seite sind die Nerven *1c* und *0i* kopfwärts zu einem verschmolzen; der rechte *1c* bietet hier weiter die Eigenart, dass er scheinbar von dem *1i* entspringt, d. h. eine weite Strecke mit derselben äusserlich verschmolzen ist. In Fig. 5 »münden« die *1c* und *0i* beiderseits mit einem gemeinsamen Stück in den Cruralis-Plexus hinein. In Fig. 6 ist auf der linken Körperseite sowohl *1c* wie *0i*, auf der rechten nur *0i* vorhanden; in Fig. 7 fehlt beiderseits die Wurzel *1c*. Innerhalb jeder der genannten Corviden-Arten habe ich beides gefunden: bald das Vorhandensein von sowohl *1c* wie *0i*, bald ein Wegfall von *1c*, während *0i* stets vorhanden ist. Wenn man allein solche Fälle wie den in Fig. 7 dargestellten vor sich hätte, könnte natürlich die Deutung zweifelhaft sein: unsere *0i* könnte als *1i* angesprochen werden, unsere *2c* als *1c*; der Vergleich der ganzen Reihe zeigt aber, dass unsere Deutung zweifellos ist; ganz besonders lehrreich ist die Fig. 6, wo nur auf der einen Seite die *1c* weggefallen ist.

Auch bei dem einzigen Exemplar von *Buteo vulgaris* (Textfig. 13), das ich untersuchen konnte, war die Wurzel *0i* vorhanden. *1c* und *0i* kreuzen sich und sind an der Kreuzungsstelle verwachsen; abweichend von Picus viridis ist es, dass *0i* von der *2c* dicht bei dem Nervenloch entspringt. Der Cruralis-Plexus wird hier von vier Wurzeln gebildet. — Bei einem *Gypogeranus* (Textfig. 14) ist auf der linken Seite das X, das bei Buteo die beiden sich kreuzenden Nerven bilden, derartig geändert, dass die zwei oberen Äste des X verschmolzen sind und das derartig entstandene Nervenstück verbindet sich mit der *2c* dicht bei deren Austritt aus dem Nervenloch, während die unteren Äste des X sich mit der *1i* ähnlich wie bei Buteo verbinden. Auf der rechten Seite fehlt scheinbar völlig die *1c*, während dagegen die über-

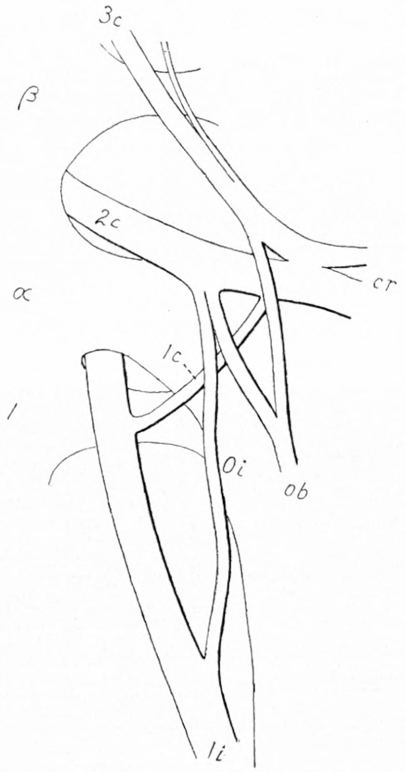

Fig. 11. Stück der linken Seite des auf Tab. 11 Fig. 3 abgebildeten Präparates (Corvus frug.), mehr vergr. *1c—3c* die drei Wurzeln des Cruralis-Plexus. *cr* N. cruralis. *0i* überzählige Ischiadicus-Wurzel. *1i* Ischiadicus-Wurzel Nr. 1. *ob* N. obturatorius. *α*, *β* letzter und vorletzter Wirbel des I. Abschn. *1* erster Wirbel des II. Abschnittes.

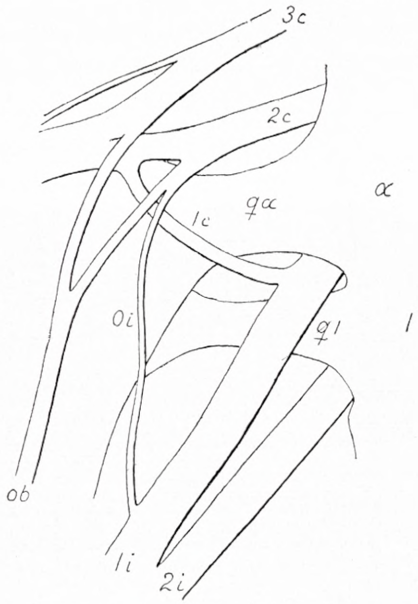

Fig. 12. Stück der rechten Seite des auf Tab. 11 Fig. 3 abgebildeten Präparates. *q1* Querfortsatz von 1II. *qα* derselbe von Wirbel *α*. *2i* zweite Isch.-Wurzel. Die anderen Buchstaben wie in Fig. 11.

zählige Ischiadicus-Wurzel *0i* wohlentwickelt vorhanden ist. Es ist aber wohl nicht völlig ausgeschlossen, dass in diesem Nerv auch eine *1c* versteckt ist, was nach einem Vergleich mit dem linksseitigen Nerv nicht eben unwahrscheinlich erscheint. — Während bei den genannten Tag-Raubvögeln — jedenfalls bei den untersuchten Exemplaren — nicht-typische Verhältnisse vorliegen, verhalten dagegen mehrere Exemplare von *Accipiter nisus* sich durchaus typisch. Dasselbe gilt auch dem einzigen *Haliaëtus albicilla*, dessen Nerven ich untersuchen könnte (Tab. 10, Fig. 8). Bei diesem ist aber an dem ersten Wirbel des Abschnittes II ein recht starker Querfortsatz vorhanden, der jedoch gegen den des Wirbels α zurücksteht. Über diesen Querfortsatz des 1_{II} verläuft natürlich die Wurzel *1 i*. Wollte man den diesen Querfortsatz tragenden Wirbel als α deuten, würde die hier als *1 i* gedeutete Wurzel eine *0 i* sein (und die *1 c* würde fehlen); für eine solche Deutung spricht aber nichts.

Der Plexus lumbosacralis des einzigen Nacht-Raubvogels, *Otus brachyotus*, den ich untersucht habe, ist in Tab. 11, Fig. 8 abgebildet. Man sieht hier beiderseits hinter

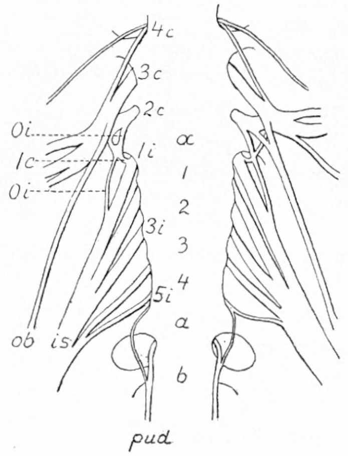

Fig. 13. Lumbosacral-Plexus von *Buteo vulgaris*. Jederseits wohlentwickelte *0i* und *1c*, sich kreuzend.

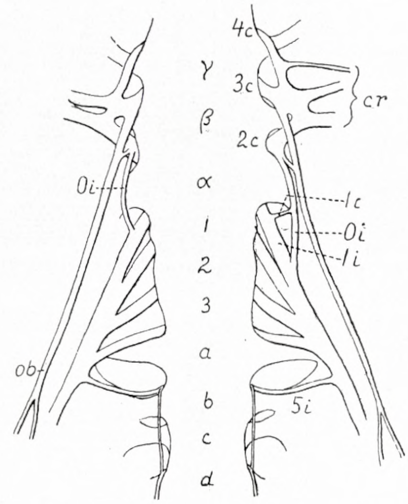

Fig. 14. Lumbosacral-Plexus von *Gypogeranus secretarius*. *0i* beiderseits, *1c* nur einerseits vorhanden.

dem Wirbel α die Wurzel *1 c* in gewohnter Weise mit der *1 i* zusammen aus dem Nervenloch heraustreten, oder richtiger von der Basis der *1 i* abgehen. Der Nerv spaltet sich aber vor seiner Vereinigung mit dem Cruralis-Plexus in zwei kurze Äste, von denen der eine, der hintere, offenbar das Ende der *1 c* ist, während der andere, der gegen die Basis der *2 c* gerichtet ist, eine *0 i* ist. In dem kurzen Stämmchen, das von *1 i* entspringt, sind somit sowohl eine *1 c* wie eine *0 i* eingeschlossen; vergleichen wir den Fall mit dem von Buteo, sind somit hier — im Gegensatz zu Gypogeranus — die caudalen Äste des X verschmolzen, die vorderen getrennt geblieben.

Ähnlich wie der oben beschriebene Gypogeranus sich auf der linken Seite verhielt, ist das Bild von dem in Tab. 12, Fig. 4 dargestellten Plexus einer *Ardea cinerea* beiderseits. Diese Ardea besitzt auf beiden Seiten eine überzählige Ischiadicus-Wurzel, *0 i*, die sich mit der letzten Cruralis-Wurzel, *1 c*, derartig vereinigt hat, dass ein Gebilde entstanden ist, das dem griechischen λ (Lambda) ähnlich ist. Abweichend von dem Gypogeranus ist nur, dass die Wurzel *1 c* nicht wie bei diesem eine Strecke weit mit der *1 i* zusammenhängt, sondern selbständig aus dem Nervenloch heraustritt. Ein ähnliches Bild wie bei dieser Ardea habe ich noch bei einem anderen

Exemplar derselben Art gefunden. Bei mehreren anderen Exemplaren von Ardea cinerea — und das scheint das häufigere zu sein — ist dagegen (Tab. 12, Fig. 5) das Verhalten ähnlich wie an der rechten Seite des Gypogeranus, d. h. die Wurzel *1c* fehlt, und nach der Weise in welcher die *0i* sich mit den anderen Ischiadicus-Wurzeln, namentlich auf der rechten Seite in dem abgebildeten Fall, verbindet, scheint es mir nicht wahrscheinlich, dass der betreffende Nerv auch eine *1c* enthalten sollte.

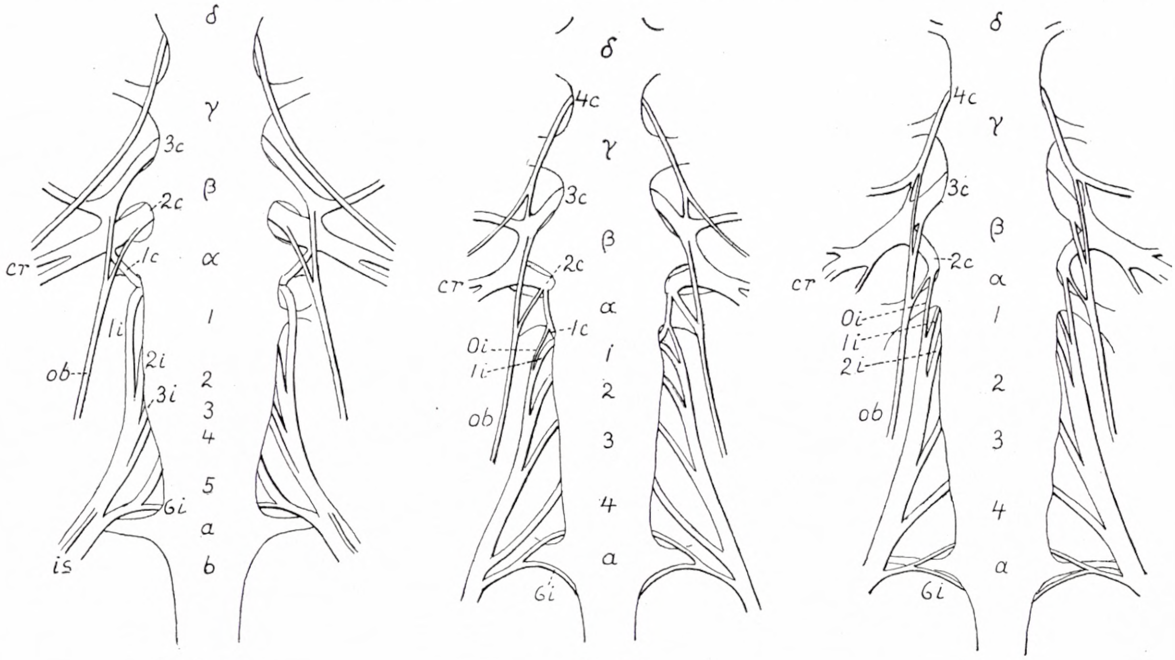

Fig. 15. Fig. 16. Fig. 17.

Fig. 15—17. Wechselnde Ausbildung des Lumbosacral-Plexus bei drei Exemplaren von *Fulica atra*. In Fig. 15 haben wir das typische Bild, in 16 ist jederseits eine *0i* und eine *1c* vorhanden, in 17 ist *0i* vorhanden, während *1c* fehlt.

Bei einem der untersuchten Störche, *Ciconia alba*, Tab. 12, Fig. 1, liegen die Verhältnisse ganz wie bei der erstgenannten Ardea; bei einem anderen (Tab. 12, Fig. 2) ist die λ-Wurzel nur auf der einen Seite vorhanden, während auf der anderen Seite ein wenigstens scheinbar einfacher Nerv vorhanden ist. Bei einem dritten Storch (Fig. 3) sind dagegen die Verhältnisse ganz die gewöhnlichen typischen: eine *0i* ist nicht vorhanden, die *1c* dagegen in typischer Weise entwickelt.

Weiter habe ich bei verschiedenen Formen der Ralliden die *0i* gefunden. Die Textfig. 15—17 illustrieren dies für die *Fulica atra*. Bei dem in Fig. 15 abgebildeten Exemplar haben wir den bei den Vögeln gewöhnlichen Typus: hier ist keine *0i* entwickelt. In der folgenden Textfig. 16, haben wir dagegen fast genau dasselbe Bild wie beim Storch in Tab. 12, Fig. 1, bei Ardea in Tab. 12, Fig. 4, oder bei der Krähe in Tab. 11, Fig. 5: *0i* ist vorhanden, die Nerven *1c* und *0i* teilweise orad verschmolzen, caudad getrennt. Endlich in Textfig. 17 ist die *1c* in Wegfall gekommen, die *0i* allein übrig geblieben, ganz wie bei Corvus frugilegus Tab. 11, Fig. 7. Bei dem in Textfig. 18 abgebildeten *Porphyrio* (ebenfalls eine Rallide) sind sowohl *1c* wie *0i* vorhanden, also insoweit wie in Textfig. 16. Diese zwei Nerven sind auch hier teilweise mit einander verschmolzen, aber die gemeinsame Partie ist die caudale; kopfwärts sind sie getrennt. Bei einem anderen Exemplar von Porphyrio habe ich dasselbe gefunden, die zwei Äste sind aber kürzer. Bei zwei Exemplaren von *Gallinula chloropus* (Textfig. 19) habe ich das typische Vogelbild gefunden, bei einem dritten (Textfig. 21), das sich sonst aufs engste an 19 anschliesst, ist dagegen *1c* in Wegfall, die *0i* aber zur Entwicklung gekommen. Ich habe nur diese drei Exemplare von Gallinula untersuchen können; ich zweifle aber nicht daran, dass eine Untersuchung weiterer Exemplare ebenso wie für Fulica atra ein Exemplar wie das in Textfig. 16 abgebildete abgeben würde[1]).

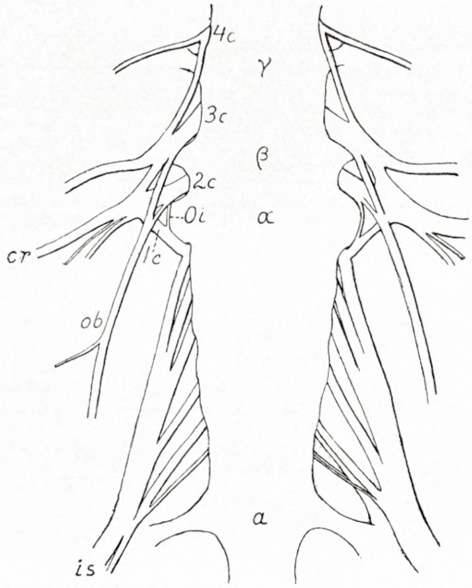

Fig. 18. Lumbosacral-Plexus von *Porphyrio* sp. *0i* und *1c* beiderseits vorhanden.

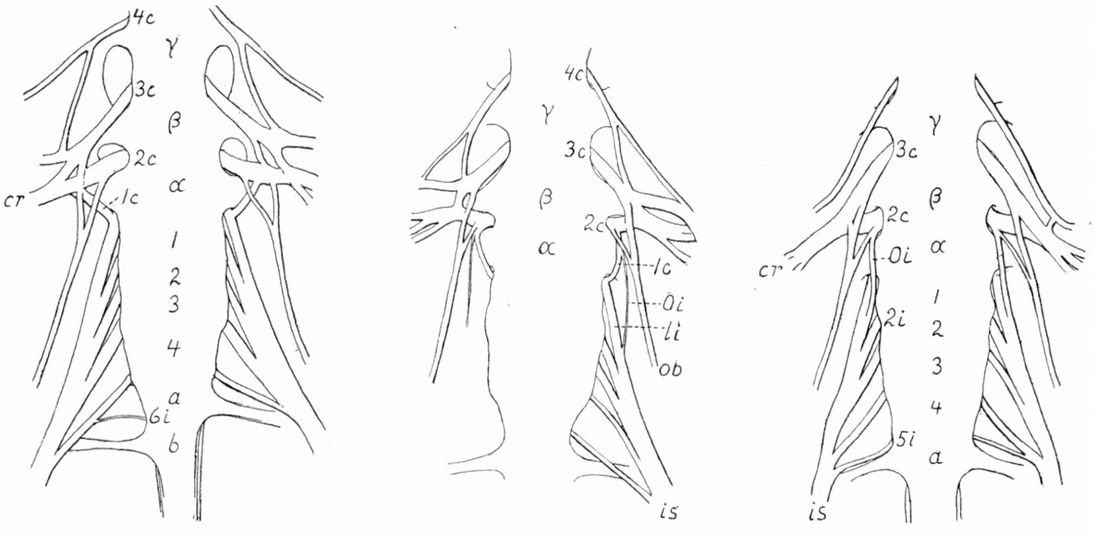

Fig. 19. Fig. 20. Fig. 21.

Fig. 19—21. Wechselnde Ausbildung des Lumbosacral-Plexus bei drei Exemplaren von *Gallinula chloropus*. Ganz ebenso wie Figg. 15—17 von Fulica. — Am Wirbel *a* nur links ein Ventralast.

[1]) Das hat sich denn auch in der Folge bewahrheitet. Einige Zeit nach der Reinschrift des Obigen erhielt ich zwei weitere Exemplare von *Gallinula chloropus*, von denen das eine sich eben in der vorausgesagten Weise verhielt (Textfig. 20).

Auch unter den Ratiten habe ich die überzählige Ischiadicus-Wurzel *0i* gefunden.

Von *Rhea* habe ich den Lumbosacralplexus bei zwei Exemplaren untersuchen können. Bei dem einen finden sich sowohl *1c* wie auch *0i* (Textfig. 22), die mit einem

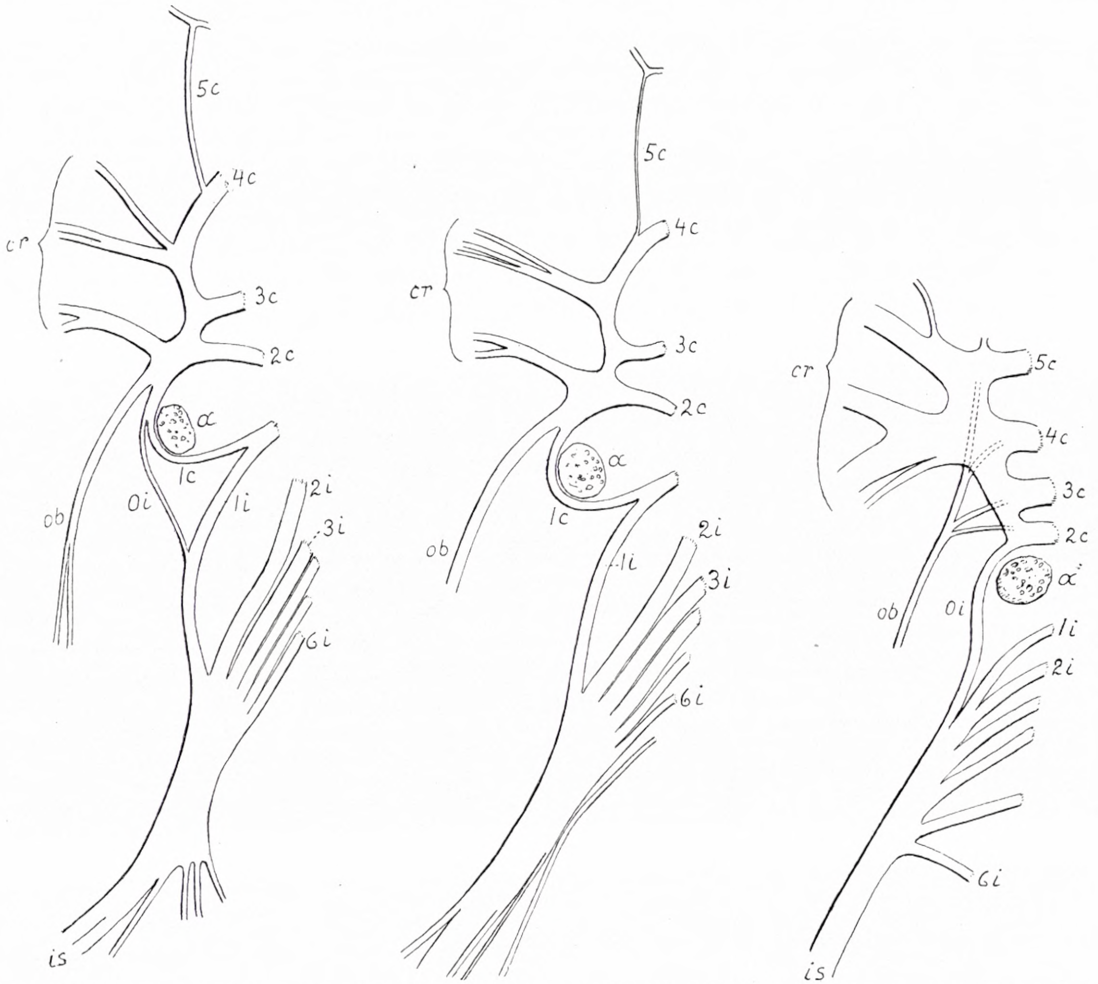

Fig. 22. Plexus lumbosacralis einer *Rhea*. Linke Seite von der Dorsalseite gesehen. *α* ist das Ende des Querfortsatzes vom Wirbel *α* (das übrige Skelett ist fortgelassen). *0i* und *1c* beide vorhanden.
Fig. 23. Dasselbe von einem anderen Exemplar von *Rhea*. Hier fehlt *0i*.
Fig. 24. Dasselbe von *Dromaeus*. Hier ist *0i* vorhanden, während *1c* fehlt.

gemeinsamen kurzen Stämmchen sich mit der *2c* verbinden. Bei dem anderen (Textfig. 23) ist nur *1c* vorhanden, das Exemplar bietet also das typische Verhalten dar.

Bei dem einzigen *Dromaeus* (Textfig. 24), den ich untersuchen konnte, fehlt dagegen *1c*, während *0i* vorhanden, und zwar sehr kräftig, ist.

In Anschluss an die hier gegebenen Mitteilungen über das Vorhandensein einer vorderen überzähligen Ischiadicus-Wurzel, *0i*, bei verschiedenen Vögeln sollen einige Fälle erörtert werden, in denen zwar keine solche vorhanden ist, bei denen sich aber während meiner Untersuchung die Frage erhoben hat, ob ein vorhandener Nerv möglicherweise als *0i* gedeutet werden sollte.

Bei den Lamellirostren findet man sehr häufig — vielleicht in der Regel — als individuelle Ausbildung, dass am ersten Wirbel des II. Abschnittes ein Querfortsatz-Ventralast vorhanden ist. Derselbe kann ganz schwach sein, er kann aber auch stärker sein und durch alle Grade sich der Stärke des voranliegenden Ventralastes des Wirbels *α*, des Endwirbels des I. Abschnittes, nähern oder gar gleichkommen, so dass es schwierig sein kann zu

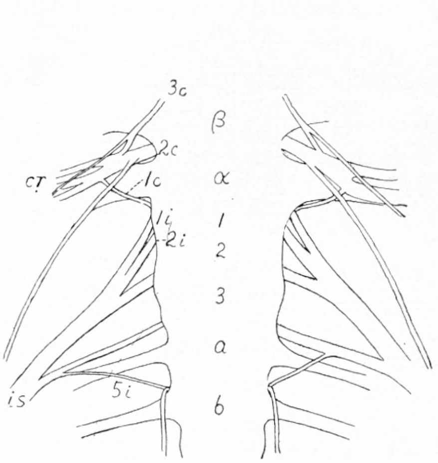

Fig. 25.

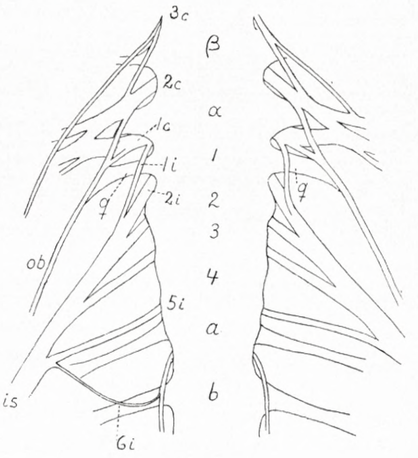

Fig. 26.

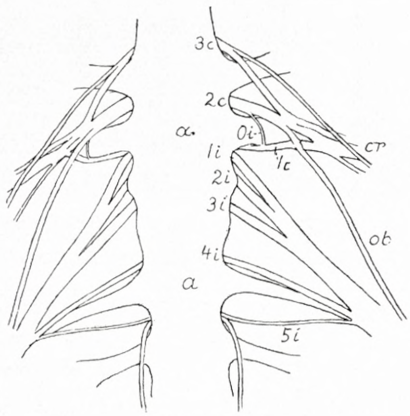

Fig. 27.

Fig. 25—27. Plexus lumbosacralis von drei Exemplaren von Anas crecca. Fig. 25—26 beide ganz typisch, 26 aber wie bei den meisten Lamellirostren mit einem grossen Ventralast (*q*) am Wirbel 1_{II}, der bei 25 fehlt. 27 zeichnet sich vor allen sonst von mir untersuchten Lamellirostren durch das Vorhandensein einer vermeintlichen *0i* aus.

entscheiden, ob der betreffende Wirbel der letzte des I. oder der erste des II. Abschnittes ist. Bemerken können wir noch, dass der fragliche Ast fast nie — wie der von *α* — an seinem distalen Ende mit dem Ilium knöchern verwachsen ist, sondern nur mit Bindegewebe an dasselbe geknüpft ist. Jedenfalls wird aber eine Untersuchung der Nerven die Sache entscheiden, indem ja die letzte Wurzel des Plexus cruralis und die erste Wurzel des Pl. ischiadicus hinter dem Ventralast des *a* hervortreten. Bisweilen können aber die Verhältnisse doch einigermassen Schwierigkeit bereiten.

Ziemlich einfach stellen sich noch die Verhältnisse in einem Fall wie der in den Textfiguren 25—26 illustrierte. In der Textfig. 25 haben wir den Plexus lumbosacralis einer *Anas crecca*, der ganz typisch ist. Der Plexus cruralis ist von drei Wurzeln gebildet, von denen die caudale Wurzel, *1c*, wie oftmals bei den Vögeln, ziemlich dünn ist und den starken Ventralast von *α* schräg überläuft. Im Abschnitt I sind 5 Wirbel vorhanden; *α* ist also Nr. 5 der Kreuzbeinwirbel. An dem 1. Wirbel des II. Abschnittes ist kein Ventralast vorhanden. In der nebenanstehenden Fig. 26 ist der Plexus einer anderen Anas crecca abgebildet. Hier ist die Abweichung im Vergleich mit der vorhergehenden Figur, dass *1c* weitaus kräftiger ist, etwa der *2c* gleichkommt. Weiter findet sich der Unterschied, dass am 1_{II} ein recht starker Ventralast vorhanden ist, der jedoch wesentlich schwächer als der von *α* und auch nur teilweise verknöchert ist, quer über denselben läuft *1i*, die schwächer ist als die entsprechende in Fig. 25. Ein Zweifel bezüglich welcher Wirbel als *α* aufzufassen ist, kann hier kaum aufkommen, um so mehr als auch bei diesem Exemplar der von uns als *α* bezeichnete Wirbel der fünfte der ganzen Reihe ist. Wollte man den von uns als 1ɪɪ gedeuteten Wirbel für *α* halten, wäre unsere *1i* als *0i* aufzufassen, der *1c* verloren gegangen und unsere *1c* als *2c* zu deuten. Dafür spricht aber nichts.[1])

Etwas schwieriger stellt es sich in dem jetzt zu besprechenden Fall, der die *Somateria mollissima* betrifft. In den Figg. 5—6, Tab. 13 sind die Lumbosacralplexus zweier Somateria abgebildet. Bei beiden ist der von uns als *α* gedeutete Wirbel der 5. der Kreuzbeinwirbel. In dem in Fig. 5 abgebildeten Fall ist der Cruralis-Plexus durchaus typisch und dem von Anas crecca Textfig. 25 ähnlich, nur *1c* stärker; ein Ventralast ist am 1ɪɪ nicht vorhanden· In dem anderen Fall, Fig. 6, ist dagegen ein recht starker Ventralast am 1ɪɪ vorhanden, jedoch entschieden schwächer als der am *α*; über denselben läuft selbstverständlich die *1i*. Die Weise, in welcher dieser Nerv sich mit den anderen verbindet, ist aber eine etwas ungewöhnliche, indem er teils in den Nerv *2i* dicht bei dessen Ursprung »einmündet«, teils sich mit dem Nerv *1c* recht weit von dem Nervenloch verbindet, aus welchem sie beide typisch gemeinsam herauskommen, und auf der linken Körperseite findet diese Verbindung unter einem ungefähr rechten Winkel statt, während es nach der Richtung des Nervenfaserverlaufes in einem *1i* natürlich wäre, dass die Verbindung mit dem *1c* unter einem laterad s p i t z e n Winkel stattfände. Auch die Verbindung von *1i* mit *2i* ist eine etwas ungewöhnliche. Die Weise, in welcher dieser Nerv sich mit den anderen verbindet, ist überhaupt derart, dass es nicht ohne weiteres von der Hand zu weisen wäre, dass derselbe die Wurzel *1c* wäre. Der Vergleich der beiden Figuren und der folgenden macht es aber natürlicher und einfacher unsere Deutung zu wählen.

Betrachten wir noch die Verhältnisse, die ich bei *Cygnus* gefunden habe Tab. 13, Figg. 1—3. Bei allen drei abgebildeten Exemplaren ist der von uns als 1ɪɪ bezeichnete Wirbel mit einem sehr starken Ventralast versehen, der dem von *α* ungefähr gleichkommt. Bei dem in Fig. 1 abgebildeten Exemplar kann darüber kein Zweifel aufkommen, dass der Nerv, der diesen Fortsatz überquert, die Ischiadicus-Wurzel *1i* ist; die Art in welcher er sich von dem *1c* abzweigt und sich mit dem *2i* verbindet ist die typische. Schon in der Fig. 2 liegen die Verhältnisse nicht ganz so typisch, namentlich ist die Weise, in welcher der fragliche Nerv sich auf der linken Körperseite mit der Cruralis-Wurzel verbindet, überraschend; nach der Weise, in welcher er sich mit dem Nerv *2i* verbindet, kann man aber wohl nicht über die Richtigkeit unserer Deutung in Zweifel sein. Bezüglich der Deutung desselben Nervs in Fig. 3 wird man wohl aber — wie ich es lange Zeit war — nicht mit Unrecht unschlüssig sein können. Der Nerv verbindet sich nämlich in solcher Weise mit den anderen Nerven, namentlich mit der Cruralis-Wurzel, dass zunächst die Deutung desselben als die *1c* die natürlichste erscheint; der Vergleich mit den zwei anderen Figuren scheint aber für unsere Deutung entscheidend zu sein. Auch ist es aus anderen unserer Nerven-Figuren zu entnehmen, dass auch bei anderen Vögeln eine zweifellose *1i* sich in ähnlicher Weise von der *1c* abzweigen kann (Textfig. 29; Tab. 14 Fig. 4 und 6).

Die oben (p. 21—26) erwähnten Abweichungen des Plexus lumbosacralis von dem typischen Verhalten hatten das gemeinsame, dass es sich um eine ü b e r z ä h l i g e I s c h i a d i c u s - W u r z e l handelte, mit oder ohne Abortierung der letzten Cruralis-Wurzel.

[1]) Ein drittes Exemplar von *Anas crecca* (Textfig. 27) das sich sonst dem erstbeschriebenen anschliesst, zeichnet sich dadurch aus, dass ein Connectiv zwischen den Wurzeln *1c* und *2c* beiderseits vorhanden ist. Ich deute diesen Nerv als eine unvollkommene *0i*, die also auch — wenn auch sehr ausnahmsweise — innerhalb der Lamellirostres vorkommt. Nachträglicher Einschuss.

Bei den Abweichungen, zu denen wir jetzt übergehen, handelt es sich um eine caudale überzählige Cruralis-Wurzel.

In Fig. 1, Tab. 14 ist der Plexus von einem Auerhahn, *Tetrao urogallus,* abgebildet. Derselbe bietet vollkommen das typische Bild dar: es sind drei starke Cruralis-Wurzeln vorhanden, von denen die letzte hinter dem starken Ventralfortsatz des Wirbels *α* heraustritt; mit ihr ist eine kurze Strecke die erste Ischiadicus-Wurzel verbunden. Es sind im Ganzen fünf Ischiadicus-Wurzeln vorhanden, von denen die letzte vor dem Wirbel *a* liegt.

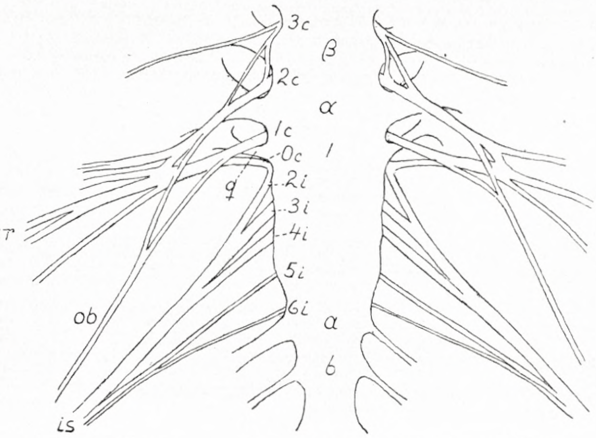

Fig. 28. Plexus lumbosacralis von einem *Tetrao tetrix.* Fast genau wie Tetrao urogallus Tab. 14 Fig. 2, aber an 1_{II} ein starker Ventralast (*q*).

In derselben Tab. 14 Fig. 2 ist der Plexus von einem anderen Auerhahn abgebildet. Es sind dieselben drei Cruralis-Wurzeln vorhanden, von denen die erste (*3 c*) schwächer ist als die beiden anderen und schwächer als bei dem ersten Exemplar. Die letzte der drei Wurzeln tritt wie gewöhnlich aus dem Nervenloch hinter dem Wirbel *α* heraus. Aber zu diesen Wurzeln gesellt sich noch eine vierte, *0 c,* die aus dem folgenden Ner-

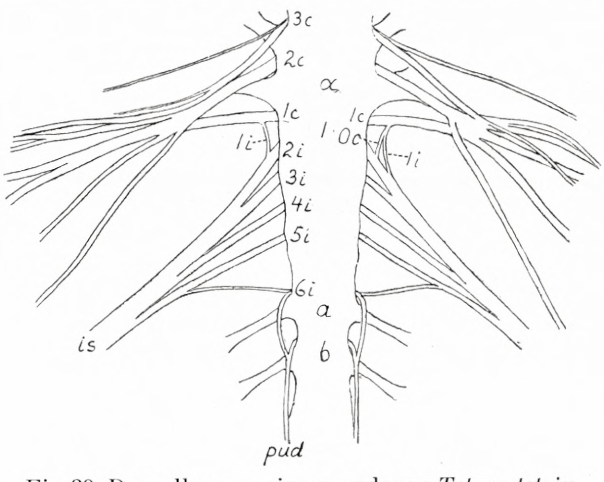

Fig. 29. Dasselbe von einem anderen *Tetrao tetrix,* ebenfalls mit *0c,* aber nur an der linken Seite, und mit *1i* beiderseits.

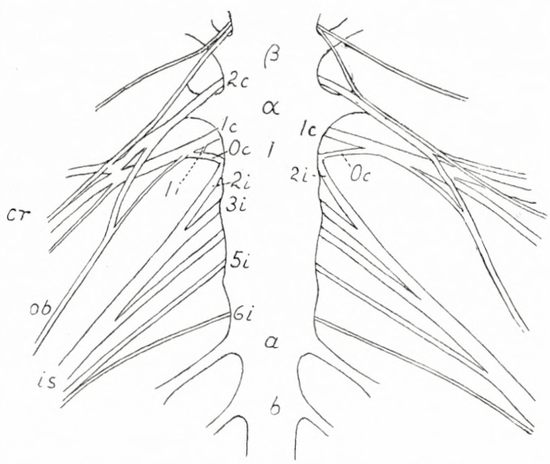

Fig. 30. Dasselbe von einen dritten *Tetrao tetrix,* bei dem *0c* beiderseits wohl entwickelt ist und auf der rechten Seite die Andeutung einer *1i.*

venloch heraustritt, also dem zwischen den Wirbeln 1_{II} und 2_{II}, und mit dieser überzähligen Cruralis-Wurzel verbunden, tritt erst hier die erste der vorhandenen

Ischiadicus-Wurzeln hervor, während die Ischiadicus-Wurzel *1 i*, die aus dem Loch hinter *α* heraustreten sollte, fehlt. Der erste Wirbel des II. Abschnittes ist in gewöhnlicher Weise ausgebildet, namentlich besitzt er keinen Ventralast. Die Zahl der Ischiadicus-Wurzeln ist wie bei dem ersten Exemplar fünf, von denen auch hier die letzte vor dem Wirbel *α* liegt, indem hier in dem II. Abschnitt 5, in dem ersten Fall nur 4 Wirbel vorhanden sind. — Derartig wie bei dem letztbeschriebenen Exemplar scheinen die Verhältnisse gewöhnlich bei Tetrao urogallus zu liegen: von vier untersuchten Exemplaren besitzen die drei die überzählige Wurzel. — Hier kann noch bemerkt werden, dass keines von den untersuchten Exemplaren einen Ventralast an dem 1_{II} besitzt.

Eine andere Deutung als die hier gegebene dürfte ausgeschlossen sein. Die Art in welcher der überzählige Nerv sich mit der Wurzel *1 c* verbindet, nämlich unter einem spitzen Winkel, dessen Spitze laterad gerichtet ist, macht es unmöglich denselben als eine *1 i* aufzufassen, auch habe ich das Faserbündel desselben nach der Vereinigung mit *1 c* weiter laterad verfolgen können.

Wie im Voraus zu erwarten war, verhält sich der nahe verwandte Birkhahn, *Tetrao tetrix* (Textfigg. 28—30, p. 29), ähnlich wie der Auerhahn. Von den 6 Exemplaren des Tetrao tetrix, die ich untersucht habe, verhalten sich die vier (Textfig. 28) wie die drei oben erwähnten Auerhähne: es ist eine überzählige Cruralis-Wurzel, *0 c*, vorhanden, die sich ganz wie bei dem Auerhahn Tab. 14, Fig. 2 verhält, und die *1 i* fehlt. Bei zwei dieser vier Exemplare ist kein Ventralast am 1_{II} entwickelt, bei den zwei anderen (Textfig. 28) ist dagegen ein solcher vorhanden, bei dem einen jedoch nur auf der linken Seite.

Das eine von den beiden noch zu erwähnenden Exemplaren von Tetrao tetrix (Textfig. 29) verhält sich auf der rechten Körperseite wie der Tetrao urogallus Tab. 14, Fig. 1 beiderseits: eine *0 c* ist nicht entwickelt, dagegen ist die *1 i* vorhanden (also das typische Verhalten der Vögel). Auf der linken Körperseite ist die *1 i* ebenfalls vorhanden, hier ist aber auch eine *0 c* entwickelt, die jedoch kopfwärts mit der *1 i* verwachsen ist. — Bei dem sechsten Exemplar (Textfig. 30) liegen die Verhältnisse wieder anders. Hier ist auf der linken Körperseite die *0 c* ähnlich wie beim Auerhahn Fig. 2 entwickelt und hier fehlt auch *1 i*. Auf der rechten Körperseite ist *0 c* ebenfalls vorhanden, hier gibt sie aber kopfwärts ein Ästchen ab, das offenbar das Kopfende der *1 i* ist, die sonst mit der *0 c* verschmolzen ist. — Bei keinem von diesen beiden Exemplaren ist ein Ventralast am 1_{II} vorhanden.

Auch bei gewissen Scolopaciden kann die überzählige Cruralis-Wurzel *0 c* auftreten. So z. B. bei der Gatt. *Totanus*. In den Figg. 3 und 4, Tab. 14 ist der Plexus von zwei Exemplaren von Totanus abgebildet, bei denen die typischen Verhältnisse vorliegen; bei dem Exemplar Fig. 4 ist nur das abweichende, dass *1 i* eine kurze Strecke mit der *1 c* vereinigt ist, so dass sie von letzterer und nicht direkt aus dem Nervenloch entspringt; weiter ist bei diesem Exemplar zu merken, dass 1_{II} mit einem Ventralast des Querfortsatzes ausgestattet ist. Bei dem Exemplar Fig. 5, bei dem ebenfalls der genannte Ventralast vorhanden, ist dagegen im Gegensatz zu jenem Exemplare auf der rechten Seite eine ähnliche überzählige Cruralis-Wurzel *0c* wie bei dem Tetrao urogallus Fig. 2 ausgebildet; auf der linken Seite ist dieselbe Wurzel ebenfalls vorhanden, hier gibt sie aber vor der Einmündung in *1c* ein medianes Ästchen ab, das als die auf der anderen Seite fehlende *1i* gedeutet werden muss. Endlich in der Fig. 6 haben wir einen Fall, der sich auf der rechten Seite ähnlich verhält wie der vorhergehende auf der linken Seite, während hier auf der linken Seite ein einfacher Nerv vorhanden ist, der als eine etwas absonderliche *1i* aufzufassen ist.

Bei mehreren Exemplaren des ebenfalls den Scolopaciden angehörigen *Machetes pugnax* habe ich die typischen Verhältnisse gefunden (Tab. 15, Fig. 1—2). Aber eines der untersuchten Exemplare verhält sich abweichend. Bei diesem (Fig. 3) ist jederseits ein nicht starker Ventralast am 1_{II} vorhanden, was bei den anderen nicht der Fall ist. Bei demselben wird der Plexus cruralis in ähnlicher Weise wie bei den anderen von drei Wurzeln gebildet, von denen die beiden hinteren die stärksten sind. Auf der linken Körperseite verhalten die Wurzeln des Plexus ischiadicus sich ebenfalls in gewohnter Weise, die *1i* entspringt mit der *1c* zusammen aus dem Loch hinter dem Wirbel α und verbindet sich mit *2i* in einigem Abstand von dem Ursprung der letzteren unter einem spitzen Winkel. Auf der rechten Seite ist es aber anders. Hier fehlt die *1i* und es ist eine überzählige Cruralis-Wurzel entwickelt, die aus dem Loch zwischen 1_{II} und 2_{II} mit der Ischiadicus-Wurzel *2i* zusammen heraustritt und schräg laterad verlaufend sich mit der letzten normierten Cruralis-Wurzel, *1c*, vereinigt. Auf dieser Seite haben wir nur 5 Ischiadicus-Wurzeln, auf der anderen Seite 6, was bei den anderen abgebildeten Machetes-Exemplaren beiderseits der Fall ist.

Auch bei einigen Exemplaren von *Scolopax gallinago* habe ich eine *0c* gefunden. Von den 9 untersuchten Exemplaren dieser Art verhalten sich die 7 in typischer Weise (Tab. 15, Fig. 4—5). Ein achtes Exemplar (Fig. 6) bietet dagegen dasselbe Bild dar wie die meisten Auerhähne (Tab. 14, Fig. 2). Es sind bei dem in Fig. 4 abgebildeten typischen Exemplar des S. gallinago die gewöhnlichen drei Cruralis-Wurzeln vorhanden, von denen die vorderste die schwächste ist; die letzte tritt mit der ersten Ischiadicus-Wurzel zusammen aus dem Nervenloch hinter α hinaus. Dieselben drei Cruralis-Wurzeln sind bei dem abweichenden Exemplar in ganz ähnlicher Ausbildung auf der rechten Seite vorhanden; auf der linken Seite fehlt die vorderste Wurzel. Dazu ist aber bei diesem beiderseits eine überzählige Wurzel, eine *0c* gekommen, die aus dem Nervenloch 1_{II}—2_{II} mit der Ischiadicus-Wurzel *2i* zusammen heraustritt; die erste Ischiadicus-Wurzel, *1i*, fehlt wie beim Auerhahn. Zwischen den Wurzeln *1c* und *0c* ist ein schwacher Querfortsatz-Ventralast des Wirbels 1_{II} ausgebildet. Endlich bei einem neunten Exemplar (Fig. 7) ist der bei dem achten Exemplar schwache Ventralast von 1_{II} stärker entwickelt und ich hatte zunächst den betreffenden Wirbel als α und eine den Ventralast kreuzende Nervenwurzel als *1c* gedeutet. Ein Vergleich mit einem solchen typischen Exemplar wie dem in Fig. 5 abgebildeten zeigt aber zur Genüge, dass die Nervenwurzel, die sich um den fraglichen Ventralast windet, eine *0c* ist, und dass der Ventralast dem Wirbel 1_{II} angehört.

Eine Andeutung einer *0c* finde ich auch bei einem Hühnchen (Tab. 10, Fig. 5).

Bei demselben ist das Verhalten auf der rechten Körperseite das typische. Auf der linken Seite ist aber statt der gewöhnlichen einfachen *1i* zwischen der *1c* und *2i* ein Nerv ausgespannt, der sich ganz wie der vorhin beschriebene auf der linken Seite bei Totanus calidris (Tab. 14, Fig. 5) ebendaselbst vorhandene verhält, sich kopfwärts gabelt und als durch Verschmelzung einer *0c* und der *1i* entstanden aufgefasst werden muss (vergl. Totanus oben p. 30—31). Bei den vielen anderen untersuchten Hühnchen wurde solches nicht gefunden. Bei dem betreffenden Exemplar ist beiderseits ein Ventralast am 1_{II} vorhanden, was aber auch bei anderen Exemplaren vorkommen kann (Tab. 10, Fig. 4).

Ebenso wie die gelegentliche Ausbildung einer überzähligen vorderen Ischiadicus-Wurzel deutet auch das beschriebene Auftreten einer überzähligen Cruralis-Wurzel auf eine gewisse Unsicherheit der Grenze der beiden Abschnitte des Lumbosacralplexus.

Bevor wir die Nerven verlassen, möchte ich ein paar Worte auf den *Nervus obturatorius* verwenden. Bei den Crocodilen (Tab. 9, Fig. 1) wird er gebildet aus zwei Wurzeln, die resp. von der vorletzten und letzten präsacralen Nervenöffnung kommen (die letzte also direkt vor dem vorderen Sacralwirbel) und sich mit einander vereinigen. Unter den von mir untersuchten Vögeln habe ich beim Huhn (Tab. 10, Fig. 4—5) dasselbe Verhalten wie bei den Crocodilen gefunden: der Nerv hat dieselben zwei Wurzeln, von denen die letzte von der Nervenöffnung hinter dem letzten Wirbel des I. Abschnittes, der nach den obigen Darlegungen der letzte Lumbarwirbel ist, kommt, die andere von der Nervenöffnung craniad von dieser; dass die Wurzeln eine Strecke weit resp. mit den Wurzeln *1c* und *2c* vereinigt sind, also von diesen entspringen, ändert natürlich nichts an der Sache. Bei einigen Exemplaren vom Huhn habe ich noch eine dritte, vorderste, Obturatorius-Wurzel gefunden, nämlich eine die von der *3c* entspringt (Fig. 2 beiderseits, und 3 einerseits). Endlich kann bei einigen Exemplaren (Fig. 1) die caudale Wurzel fehlen und der Nerv nur von den Wurzeln aus *2c* und *3c* gebildet sein.

Bei anderen Vögeln habe ich bezüglich der Obturatorius-Wurzeln bald das eine, bald das andere von dem beim Huhn gefundenen angetroffen. Bei manchen sind die zwei Crocodilus-Wurzeln vorhanden, häufiger wohl aber die von *2c* und *3c* entspringenden, während die caudale Wurzel fehlt. Bei einem Cygnus musicus (Tab. 13, Fig. 1) habe ich drei Wurzeln wie beim Huhn Fig. 2 gefunden (von *1c*—*3c*). Bei Dromaeus fand ich (Textfig. 24) vier Wurzeln, die von *2c*—*5c* entspringen. Bei einem Rhynchotus (Tab. 9, Fig. 5, rechte Körperseite) sind nur zwei Wurzeln vorhanden, die aber vom *3c* und *4c* entspringen, so dass keine von den Crocodilus-Wurzeln hier vorhanden sind. Es können aber auch die Wurzeln bis auf eine einzige reduziert sein (Tab. 9, Fig. 4). Zusammenfassend können wir sagen, dass bei den Vögeln eine Tendenz da gewesen ist weitere Wurzeln kopfwärts auszubilden, meist unter gleichzeitiger Oblitteration der letzten Wurzel (selten beider) der Crocodile.

3. Das Becken *s. str.*

und dessen Verbindung mit dem Kreuzbein.

Textfigg. 31—33, Tabulae 1—8.

Das ***Os ilium*** ist eine längliche Platte, die ganz grob in zwei Abschnitte geteilt werden kann, einen vorderen, schräg gestellten vor dem Acetabulum und einen hinteren, der meist grösstenteils etwa horizontal im Verhältniss zur Längsachse des Sacrum situiert ist. Der obere, resp. mediale Rand der Platte des vorderen Abschnittes ist bei den meisten Vögeln dem der paarigen sehr genähert oder gar mit ihm verwachsen; weiter caudad weichen die genannten Ränder stark auseinander.

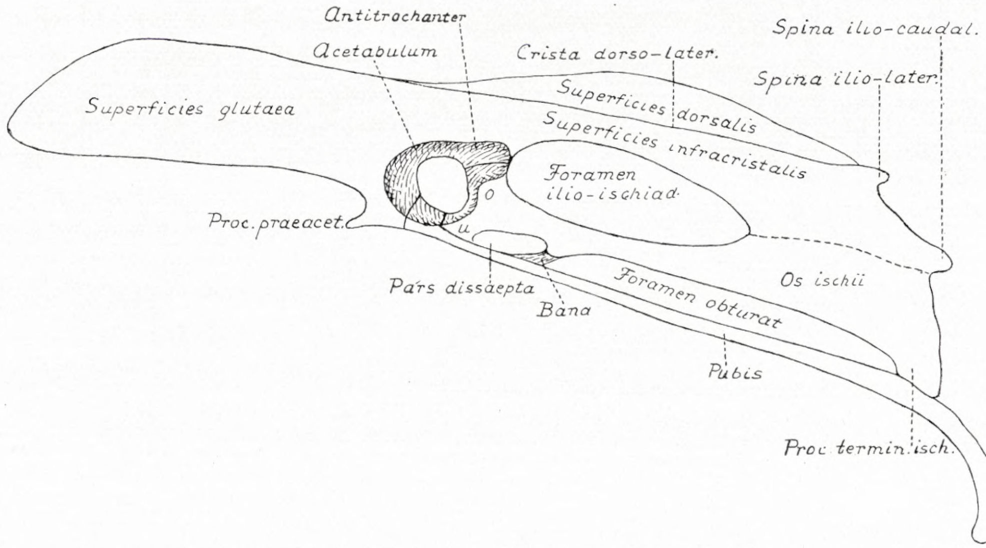

Fig. 31. Schema der linken Hälfte eines Vogel-Beckens von der lateralen Seite. *o* und *u* vergl. den Text p. 36.

Auf der Aussenseite (Textfig. 31) hat der vordere Abschnitt eine ausgedehnte Aushöhlung, die *Superficies glutaea*, die meist vorn bis an den vorderen scharfen Rand der Platte reicht. Die Superficies glutaea wird caudal abgeschlossen mit einer schmäleren Partie oberhalb des Acetabulum und stösst hier an den abgeknickten lateralen Teil des hinteren Ilium-Abschnittes. Die Oberfläche dieses abgeknickten Teiles nennen wir *Superficies infracristalis*, die von der *Superficies dorsalis*, der Oberfläche des horizontalen grösseren Teiles des hinteren Ilium-Abschnittes, durch die *Crista dorsolateralis* getrennt ist. Der abgeknickte Teil ist meist ziemlich schmal, besonders so weit er an das Foramen ilio-ischiadicum grenzt, weiter caudal wird er breiter, wo er mit dem Os ischii verwächst. Die Crista dorsolateralis trägt in einigem Abstand von ihrem Ende bei manchen (Gallus, Ralliden) einen kurzen Fortsatz, den *Processus iliolateralis*, und setzt sich weiter bis in die *Spina ilio-caudalis* fort, mit welcher das Ilium hinten abgeschlossen wird.

An der Innenseite (Ventralseite) des Ilium (Textfig. 33) bemerkt man drei wulstartige Verdickungen, von denen die beiden hinteren quer, der vorderste schräg verlaufen. Alle drei sind in Anschluss an Querfortsätze, die sich an das Ilium heften, entwickelt. Die hinterste, die ich als *Crista iliaca posterior*[1]) bezeichne, ist eine bogen-

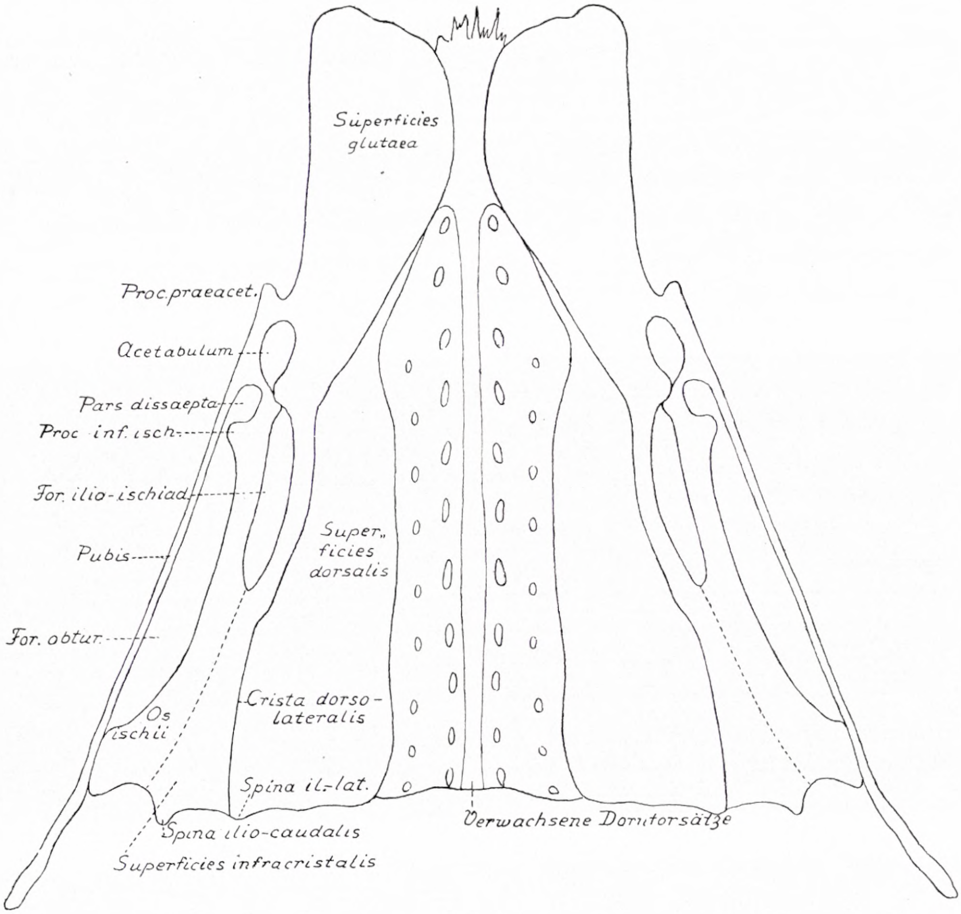

Fig. 32. Schema eines Vogel-Beckens von der dorsalen Seite gesehen, künstlich etwas abgeplattet. Die mittlere, durchlöcherte Partie ist die von der verknöcherten Fascie überkleideten Querfortsätze (vergl. Tab. 3, Fig. 9). Die punktierten Linien deuten die Grenze der Ossa ilium und ischii an.

förmige Kante, die quer über das Ilium in einigem Abstand von dessen Hinterende vom medianen zum lateralen Ilium-Rande verläuft; die Konkavität der Crista ist nach vorn gerichtet. Dieselbe ist bei einigen Vögeln sehr wenig hervortretend, nur eine be-

[1]) Sie wurde von Gegenbaur mit dem Namen *Crista ischiosacralis* belegt, weil sie sich wenn stark entwickelt in den dorsalen Rand des Os ischii fortsetzt. Da die Crista aber dem Ilium allein angehört, finde ich diesen Namen missweisend und nenne sie wie oben angegeben.

scheidene Verdickung der Ilium-Wand (Gans, Somateria, Phoenicopterus, Uria, Numenius u. a.), oder fehlt gar völlig (Schwan, Sula). Bei anderen ist sie aber stärker entwickelt und kann sich sogar derartig erheben, dass sie die ventrale Begrenzung einer taschenförmigen Vertiefung, *Recessus iliacus*, wird. Eine Andeutung dieser Tasche findet man z. B. bei Ciconia und Ardea, deutlicher ist sie schon bei Larus, Chauna und bei Scolopax rusticola, noch tiefer bei den Gruiden und bei Gallus u. a. Bei den Eulen ist ebenfalls eine sehr starke Crista und Tasche vorhanden, die laterale Taschenwand ist aber durch Ausdehnung des Foramen ilio-ischiadicum teilweise in Wegfall gekommen, so dass die Crista iliaca posterior zwar sehr stark ist, die Tasche aber nur eine bescheidene Grube ist. Ähnlich wie die Eulen verhalten sich auch die Westgeier und manche Tagraubvögel (Astur, Falco, Pernis); und bei einigen Tagraubvögeln (Aquila, Haliaëtus, Circus, Buteo) ist es noch einen Schritt weiter gegangen, indem hier die laterale Taschenwand völlig abhanden gekommen ist, so dass praktisch von einer »Tasche« nicht die Rede sein kann. — Die *Crista posterior* ist entwickelt in Anschluss an die hintersten Querfortsätze des Sacrum, die sich mit dem dorso-medialen Ende der Crista verbinden.

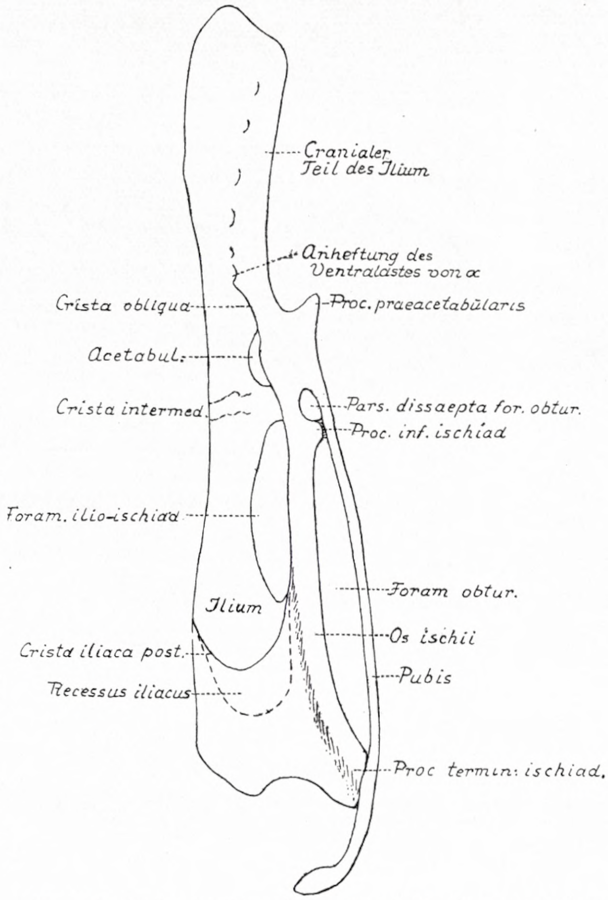

Fig. 33. Linke Hälfte eines Vogel-Beckens von der ventro-medialen Seite gesehen.

Der mittlere Wulst, die *Crista iliaca intermedia*, ist meist recht wenig hervortretend; sie liegt median vom Acetabulum oder weiter caudal und steht mit dem Ende des Querfortsatzes des Wirbels *a* (und manchmal auch von *b*) in Verbindung. Sehr stark habe ich die Crista bei Sterna (Tab. 2, Fig. 14) gefunden, bei den meisten Vögeln ist sie aber eine nicht sehr auffällige Verdickung der Ilium-Wand (derartig z. B. beim Huhn und Lagopus, Tab. 4, Fig. 1).

Endlich der vorderste Wulst, die *Crista iliaca obliqua*, verläuft von der Ansatzstelle des Querfortsatzes des Wirbels *a* schräg caudal und etwas laterad bis an das Acetabulum; diese Crista bildet die verdickte hinterste abgerundete laterale Randpartie des vorderen Abschnittes des sonst scharfrandigen Ilium. Die Crista ist bei einigen,

z. B. bei Tetrao urogallus, sehr hervortretend, während sie bei anderen einfach als eine lokale Verstärkung des Ilium-Randes erscheint.

Das ***Os ischii*** (Textfig. 31) kann mit einem Messer verglichen werden mit kürzerem oder längerem, breiterem oder schmälerem dreieckigem Blatt, das gegen das Ende breiter wird, und das von einem kurzen Griff getragen wird, der am Ende in zwei kurze, starke Fortsätzchen hinausläuft. Das eine von diesen Fortsätzchen (*o*) bildet die hintere (caudale) Begrenzung des Acetabulum und trägt mit dem angrenzenden Teil des Ilium zusammen den *Antitrochanter*. Das andere Fortsätzchen (*u*) bildet einen Teil der ventralen Umgrenzung des Acetabulum und stösst hier mit dem Körper des Os pubis zusammen. Das Os ischii hat einen oberen und einen unteren scharfen Rand; das »Blatt« ist meist derartig gedreht, dass der untere Rand mehr oder weniger lateral gerichtet ist. An der Grenze des »Griffes« und des »Blattes« trägt der untere Rand ein Fortsätzchen, den *Processus inferior* (Fig. 33), an den ein Band befestigt ist, das zu dem ventral vom Os ischii gelagerten Pubis geht; dieses Band kann manchmal (z. B. Huhn, Phasianus, Corviden, Emberiza, Plectrophanes, Sitta, Cuculus) verknöchern und das Os ischii somit mit dem Pubis hier verwachsen. Zwischen dem unteren Rand des Ilium und dem oberen des Os ischii ist — ähnlich wie bei den Ornithischia — eine offene Bucht bei den Tinamiden und einigen Ratiten: Apteryx und Struthio vorhanden. Bei allen Carinaten mit Ausnahme der Tinamiden verwachsen diese beiden Ränder in grösserer Ausdehnung von hinten nach vorn mit einander, und ein Loch, das *Foramen ilio-ischiadicum*, bei einigen grösser, bei anderen kleiner, bleibt zurück, das vorn von dem oben genannten Fortsätzchen *o* des Os ischii begrenzt wird. Auch bei Rhea, Dromaeus und Casuarius findet, in mehr begrenzter Ausdehnung, ein Verwachsen der genannten Ränder statt.

Von dem hintersten Ende des Unterrandes der Os ischii entspringt bei den meisten Vögeln ein platter, schmälerer oder breiterer, Fortsatz, der *Processus terminalis ischiadicus*, dessen Unterrand sich mittels kurzer Bänder mit dem Oberrand des Pubis verbindet. Sehr hervortretend ist dieser Fortsatz z. B. bei den Lamellirostren, Ralliden, Colymbus, ebenso bei Graculus, bei dem er ungemein ausgedehnt ist; bei manchen anderen ist zwar die hintere Spitze von Os ischii mit Bändern an das Pubis verankert, der Fortsatz aber nicht abgesetzt (Pelecanus, Columba u. a.). Bei den Gruiden fehlt er und das Ende des Os ischii steht von Pubis ab. Bei einigen geht die Verbindung des Fortsatzes mit dem Pubis in eine Verwachsung über: solches fand ich bei Sturnus, Passer dom., Emberiza, Picus, bei denen allen der Fortsatz stark abgesetzt ist.

Das ***Os pubis*** (Textfig. 31) besteht aus einem Basalstück, das in den Unterrand des Acetabulum zwischen dem ventralen Fortsätzchen (*u*) des Os ischii und einem ventralen Fortsätzchen des Ilium eingepasst ist, und einem langen dünnen säbelförmigen Knochenteil, der ventral vom Os ischii diesem einigermassen parallel verläuft. Bei den Ornithischia ist die Lagerung des entsprechenden Teiles (Postpubis) ähnlich, das Os ischii ist von demselben durch eine offene Spalte getrennt, die dem *Foramen obturatorium* anderer Reptilien und der Säugetiere entspricht. Diese Spalte, also das Forames obturatorium, ist auch bei den Vögeln vorhanden und zwar bei den meisten in ähnlicher Ausbildung wie bei den Ornithischia; bei einigen, den meisten Raubvögeln, den Hühnervögeln, ist aber das Pubis in seiner grössten Ausdehnung dem Os ischii eng angelagert; nur der vorderste Teil, vor dem oben erwähnten Processus inferior Ossis ischii, bleibt offen zum Durchgang der Sehne des Musculus obturator; dieser vordere Teil des Foramen obturatorium bleibt desshalb stets offen; er wird gewöhnlich fälschlich als das ganze For. obturatorium aufgefasst, ist aber nur ein abgrenzter Teil desselben. — Über den bei einigen Vögeln vom Pubis entspringenden *Proc. praeacetabularis* verweise ich auf meine Arbeit über das Verhältniss der Dinosaurier zu den Vögeln.

Bei den Dinosauriern liegen im Allgemeinen die beiderseitigen Ossa ilium im Verhältnis zur Wirbelsäule derartig, dass die Dornfortsätze der Kreuzbeinwirbel den oberen Rand der Ossa ilium überragen, oft weit überragen.

Bei denjenigen Dinosauriern, die nach meiner Auffassung[1]) die nächsten Verwandten der Vögel sind, nämlich die Compsognathiden, sind die Ossa ilium aber derartig gelagert, dass man, wenn das Skelett im Profil gesehen wird, von den Dornfortsätzen nichts sieht[1]) oder höchstens ein wenig von den hintersten. Dasselbe ist auch mit gewissen anderen Dinosauriern, wenigstens mit dem (den Compsognathiden verwandten?) Tyrannosaurus der Fall.

Bei den Vögeln ist es durchweg so, dass die Dornfortsätze des Kreuzbeins den oberen Rand der Ossa ilium nicht überragen sondern von denselben in der Profillage verdeckt sind; nur die hintersten Kreuzbeinwirbel können den Ilium-Rand überragen, dagegen sind die vordersten langen Dornfortsätze verdeckt. Ausnahmen hiervon — sekundäre Modifikationen —, in denen die vorderen Dornfortsätze den Ilium-Rand überragen, kommen bei verschiedenen Vögeln vor. Sehr stark tritt dieses bei der Gattung *Colymbus* (Tab. 3, Fig. 1) hervor, bei dem die ganz Reihe der langen vorderen, verschmolzenen Dornfortsätze frei hervortritt, indem der praeacetabulare Abschnitt des Ilium stark verschmälert ist, und zwar ist es der dorsale Teil desselben der nicht ausgebildet ist; auch die niedrigeren folgenden Dornfortsätze treten hervor. Ähnlich verhalten sich auch *Podicipes* und die *Spheniscíden*. Bei *Fulica* und *Gallinula* reicht zwar das vorderste Ende des Ilium-Randes so hoch hinauf, dass die Dornfortsätze hier verdeckt sind; der folgende Teil des Ilium-Randes ist aber niedriger und hier treten die verschmolzenen Dornfortsätze hervor (bei dem verwandten Porphyrio ist das nicht der Fall; hier sind die Verhältnisse die typischen). Auch bei Cuculus, Cypselus und Sterna reichen die oberen Ränder der Ossa ilium nicht so hoch hinauf, dass die Dornfortsätze, das Becken im Profil gesehen, verdeckt sind.

Der dorsale Rand des Ilium legt sich bei den Vögeln typisch am cranialen Ende des Beckens eine Strecke weit den distalen Enden der Dornfortsätze an und verwächst mit denselben. Ganz cranial weichen die Ränder wieder etwas von den Dornfort-

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[1]) Vergl. meine Abhandlung über die Dinosaurier p. 241 ff.

[2]) Vergl. Osborn 1917, Pl. 26.

sätzen ab. Caudad weichen sie allmählich von einander aus, bis sie etwa auf der Höhe mit dem Acetabulum am weitesten getrennt sind; gegen das caudale Ende zu wird der Abstand zwischen ihnen wieder allmählich etwas geringer, aber noch am caudalen Ende ist der Abstand recht gross. Die Enden der Querfortsätze des I. und auch der cranialen des II. Abschnittes heften sich an die mediale Seite des Ilium, während alle folgenden sich an den dorsalen Rand desselben heften, mit alleiniger Ausnahme des Wirbels *a*, dessen Querfortsatz sich manchmal in grösserer Ausdehnung mit der Medialseite des Ilium verbindet.

Von dem beschriebenen Verhalten des Ilium zu dem Sacrum weichen aber manche Vögel in gewissen Hinsichten ab. Bei den Singvögeln (Oscines) erreichen die Ränder der Ossa ilium nicht die Dornfortsätze, sondern sind von denselben und von einander durch einen grösseren oder kleineren Zwischenraum getrennt. Ähnlich verhalten sich auch folgende Vögel: Tinamiden, Alcedo, Tauben, Picus, Rhamphastus, Sterna, Totanus, Scolopax rusticola, und wohl viele andere. Bei einigen Vögeln geht das noch weiter: bei Cypselus (Tab. 3, Fig. 8) fehlt sogar völlig ein über das Niveau des Kreuzbeins sich erhebender Teil des Ilium; nicht viel anders ist es auch noch bei Caprimulgus und bei Cuculus. Auch bei den Sphenisciden und den schon früher erwähnten Colymbiden ist die dorsale Randpartie des vorderen Ilium-Abschnittes stärker oder schwächer reduziert.

Im Allgemeinen verwachsen im Laufe der Jugend die Beckenhälften mit dem Kreuzbein. Lebenslänglich habe ich ein Getrenntbleiben gefunden bei folgenden Vögeln: Debilirostres (Totanus, Scolopax etc.), Charadriiden (Charadrius, Strepsilas, Haematopus), Colymbiden (Colymbus, Podicipes), Spheniscus; vielleicht bleiben sie auch getrennt bei den Tinamiden. Häufiger ist es, dass der I. und II. Kreuzbein-Abschnitt mit dem Ilium verwächst, während der caudale Teil des Sacrum in grösserer oder geringerer Ausdehnung von den Ossa ilium frei bleibt; derartig habe ich es gefunden bei: Larus, Sterna, Oscines, Tauben, Hühnervögeln, Papageien.

4. Die Fascienverknöcherungen an der Dorsalseite des Kreuzbeins.

Während die Dorsalränder der Ossa ilium wie bereits erwähnt meistens über die Dorsalseite der Wirbel des I. Abschnittes des Kreuzbeines zusammenstossen, sind sie an den folgenden Abschnitten von einander getrennt. In dem Spatium zwischen ihnen sieht man an jungen Vögeln die Dorsaläste der Querfortsätze einen nach dem anderen hinter einander liegen bedeckt von einer bindegewebigen Membran (Tab. 3, Fig. 9), in welcher fünf längsverlaufende bandförmige Sehnenstreifen mehr oder weniger deutlich unterschieden werden können: einen längs der Mitte über die oberen Enden der Dornfortsätze bis an das vorderste Ende des Kreuzbeins hinziehend, einen zweiten, den ausgeprägtesten, jederseits etwas seitlich von dem ersten, und endlich jederseits ganz seitlich nahe dem medianen Ilium-rande einen schmalen Streifen. Sehr schön habe ich diese Streifen alle bei einem jungen Cygnus und bei der jungen Gans gefunden. Bei einer jungen Ente (Art unbestimmt) habe ich den mittleren und, ausserordentlich deutlich und scharf, den zweiten gefunden, während der laterale nicht unterscheidbar ist. Die Streifen sind durch eine dünne Membran vereinigt.

Diese Streifen verknöchern später und verwachsen mit den unterliegenden Dornfortsatzen und Querfortsätzen. An dem mazerierten Skelett (Tab. 3, Fig. 5—8) findet man dann zwischen den dorsalen Ilium-Rändern eine durchlöcherte Platte, indem nur die Streifen verknöchern, nicht (oder nicht zunächst) die schwächeren Membranteile. Es entstehen somit jederseits zwei Löcherreichen, nämlich resp. zwischen dem medianen Streifen und dem zweiten und zwischen letzterem und dem lateralen, selten auch noch eine dritte zwischen dem lateralen Streifen und dem Ilium-Rande (Fig. 5 u. 6). Alle Löcher sind natürlich vorn und hinten von den Querfortsätzen begrenzt. Oftmals sind die Löcher der medialen Reihe weit stärker als die der nächsten (Fig. 5), häufig geht das so weit, dass letztere ganz minimal geworden sind (Fig. 7) oder gänzlich fehlen, während die der medialen Reihe gross sind. Bei manchen Vögeln können die Löcher mit zunehmendem Alter durch zunehmende Verknöcherung geschlossen oder stark verengt werden.

5. Das Becken—Kreuzbein als Bauwerk.

Das Sacrum und Becken der Vögel bilden zusammen ein Bauwerk, das mit einem unten weit offenen Tonnen-Gewölbe verglichen werden kann; getragen wird das Gewölbe von zwei starken Pfosten, den Hintergliedmassen, auf welche hier nicht eingegangen werden soll; wir haben hier nur mit dem Gewölbe selbst zu tun.

Der Charakter eines Gewölbes oder sagen wir eines umgewälzten Bootes ist besonders am mittleren und hinteren Teil des Beckens ausgeprägt.

Das Gewölbe hat hier in der Mitte einen nach innen stark hervortretenden Kiel, etwa dem Kielschwein eines Bootes vergleichbar. Dasselbe — die Reihe der Wirbelkörper des II.—IV. Abschnittes — ist craniad am stärksten, sowohl am breitesten wie am höchsten, wird caudad niedriger und schmäler. Von ihm geht ein Teil der Wölbung aus, der ähnlich wie ein Boot von Spanten — hier den Querfortsätzen — gebildet ist, über welche eine dünne Bretterlage — die verknöcherten Fascien — ausgebreitet und mit ihnen verbunden ist. Die Spanten, deren Richtung hauptsächlich mediolaterad ist, setzen sich an ihrem Ursprung noch an den Seiten der Wirbel ein Stückchen in dorso-ventraler Richtung fort zur besseren Befestigung. An den Rand dieser gut gefestigten Platte (die Querfortsätze + die verknöcherten Fascien) heften sich dann die Beckenhälften, die den grösseren Teil des Gewölbes ausmachen; die Verbindung ist aber hier meistens keine besonders solide, eine genügende Befestigung wird aber durch das Verhalten der Beckenhälften zu dem I. Kreuzbein-Abschnitt erreicht.

In dem I. Abschnitt, in welchem der Kiel sehr stark hervortritt und sehr stark ausgebildet ist, verbinden sich die Querfortsätze in einer besonders innigen Weise mit den hier schmäleren Beckenhälften. Die betreffenden Querfortsätze sind sehr kurz und kräftig und legen sich mit einer stark verbreiterten Endfläche an die Innenseite (Unterseite) des Ilium an. Diese Verbindung, die beim erwachsenen Tier in der Regel in eine Verwachsung übergeht, ist bei manchen Vögeln die Hauptverbindung des Beckens mit der Wirbelsäule, bei allen eine der Hauptverbindungen. Die Ursprungsstellen der genannten Querfortsätze verhalten sich derart, dass während die vordersten Querfortsätze von dem Bogen allein ausgehen, rücken die folgenden successive weiter hinab auf die Seite des Wirbels. Die Unterseite des letzten Querfortsatzes liegt im Niveau mit der platten Unterseite des betreffenden Wirbels und sein ventraler Ast (der Querfortsatz ist wie früher erwähnt in zwei Äste gespalten) ist direkt seitlich gerichtet, heftet sich weit ventral dem Ilium an, während der dorsale Ast sich hoch oben an das Ilium heftet. Der ventrale Ast liegt derartig in dem Gewölbe, dass er mit einem Hahnenbalken verglichen werden kann, der von einer Seite des Gewölbes zu der anderen geht und die rechte und die linke Seite zusammenhält, resp. auseinanderhält.

Derjenige Teil des Ilium, der dorsal zu den Anheftungsstellen der beschriebenen Querfortsätze liegt, bildet gewöhnlich die laterale Wand eines dreieckigen Raumes, dessen mediane Wand von den Dornfortsätzen des I. Abschnittes gebildet wird (vergl. Tab. 1, Fig. 1—2) und in dem der hintere Teil des Musculus spinalis und des M. ascendens thoracis Platz hat. Der obere Rand dieses Teils des Ilium verbindet sich wir bereits erwähnt bei den meisten Vögeln mit dem oberen Rand der verschmolzenen Dornfortsätze. Diese Verbindung ist aber derart, dass sie für das Festhalten des Beckens an dem Kreuzbein wohl nur eine untergeordnete Bedeutung hat, und bei einigen Vögeln fehlt sie ja auch (p. 38). — Derjenige Teil des Ilium, der ventral zu den Anheftungsflächen der Querfortsätze liegt, ist im Allgemeinen recht schmal und nach auswärts gerichtet und der »Gewölbe«-Charakter tritt desshalb, wie schon vorhin bemerkt, für diesen Abschnitt des Beckens nicht deutlich zum Vorschein.

Der II. Abschnitt des Kreuzbeins ist im Gegensatz zu dem I. meistens fast ohne oder von sehr geringer Bedeutung für die Verbindung des Beckens mit der Wirbelsäule, indem die schwachen Querfortsätze nur mit einem schmalen Rand sich mit dem Rand des Ilium verbinden, ja die Querfortsätze können sogar wie ich bei gewissen Tinamiden finde in diesem Abschnitt teilweise fehlen, so dass dieser Teil des Gewölbes nur von der verknöcherten Fascie hergestellt wird. Andererseits kann aber der II. Abschnitt ausnahmsweise sehr wesentlich zum Tragen des Beckens beisteuern. Das ist z. B. bei den Pinguinen der Fall. Bei einem vorliegenden Spheniscus demersus (Tab. 2, Fig. 7), bei dem die Beckenknochen nicht mit dem Kreuzbein verwachsen waren, finde ich, dass die zwei hintersten Wirbel des II. Abschnittes kurze mit einander verwachsene Querfortsätze tragen, die eine gemeinsame breite Anheftungsfläche haben, die in die grosse Anheftungsfläche der folgenden Wirbel, *a* und *b*, sich fortsetzt, und die Verbindung mit dem Ilium wird somit eine sehr innige. Auch bei Colymbus verbinden sich die extrem verkürzten Querfortsätze des II. Abschnittes je mit einer grossen Fläche mit dem Ilium (Tab. 2, Fig. 12). Dafür sind besonders bei Spheniscus die Querfortsätze der ersten Wirbel des I. Abschnittes mit relativ bescheidenen Endflächen mit dem Ilium verbunden.

Der III. Abschnitt des Kreuzbeins, die Wirbel *a* und *b*, kann bei manchen Vögeln einen wesentlichen Beitrag zur Consolidierung des Gewölbes liefern, in anderen Fällen ist seine Rolle sehr geringfügig.

Wie schon vorhin erwähnt spielen die ventralen Äste der Querfortsätze der Wirbel *a* und *b* eine Rolle als Stützen (»Winkelbänder«) des Gewölbes (Tab. 1, Fig. 7, *qv*). Der ventrale und der dorsale Ast sind am distalen Ende mit einander vereinigt und ihre gemeinsame Endfläche heftet sich an den Rand des Ilium (Tab. 1, Fig. 7). Diese Endfläche kann in manchen Fällen von recht bescheidener Grösse sein (Fig. 7) und die Querfortsätze werden dann wenig Bedeutung für die Verknüpfung der Beckenhälften mit dem Kreuzbein haben (Hühnervögel, Lamellirostres). In anderen Fällen ist die genannte Endfläche ausgedehnter und verbindet sich nicht allein mit dem Rand des Ilium sondern die Anheftungsfläche erstreckt sich weiter auf die Innenseite des Ilium hinein, manchmal bis an das Acetabulum. Das sieht man z. B. schön bei den Tinamiden (Tab. 1, Fig. 10—11), bei denen gewöhnlich nur *a* einen ventralen Ast trägt. Die ausgedehnte Endfläche desselben heftet sich hier quer über die ganze Innenfläche des Ilium und die Verbindung des Sacrum mit dem Becken wird somit eine sehr innige und solide, um so mehr weil der untere Rand der Querfortsätze horizontal ist, die platte Unterseite des Wirbels fortsetzend, so dass die Ventraläste beider Querfortsätze zusammen als ein Hahnenbalken des ganzen Gewölbes wirken. Nicht weniger solide ist die Verbindung an dieser Stelle z. B. bei den Kranichen. An einer vorliegenden *Grus* (*Anthropoides*) *paradisea* (Tab. 2, Fig. 2) vereinigen sich die Querfortsätze von *a* und *b* gegen ihr distales Ende und heften sich an die Innenseite des Ilium bis an das Acetabulum. Die dorsalen Äste liegen hier weit von den ventralen und die Wirkung der ventralen Äste als Hahnenbalken wird dadurch um so augenfälliger.

Dass das periphere Ende des Querfortsatzes des Wirbels *a* sich an das Ilium bis in die Nähe des Acetabulum erstreckt, median von, oder hinter demselben, ist überhaupt ein unter den Vögeln weit verbreitetes Verhalten. Ich habe es, ausser bei den genannten, gefunden bei folgenden: Laridae, Ruderfüssler (Graculus, Plotus, Sula, Pelecanus), Phoenicopterus, Störche (Ciconia, Leptoptilus, Dissoura, Platalea), Ralliden, Schnepfen (Scolopax, Tringa, Numenius), Chauna (Palamedeidae), Raubvögel (am stärksten bei den Tagraubvögeln)[1].

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[1]) Dagegen erstreckt sich das Ende des Querfortsatzes von *a* (und *b*) nicht, oder wenig, auf die Ilium-Innenseite hinein bei folgenden: sämtliche Hühnervögel, sämtliche Lamellirostres mit Ausnahme der Palamedeidae und Phoenicopterus (deren Zugehörigkeit zu den Lamellirostres dadurch weiter erschüttert wird), Alcidae (Alca, Uria, Mergulus), sämtliche Oscines (Corvus, Plectrophanes, Motacilla, Sylvia, Cinclus), Tauben, Scansores (Papageien, Picus, Cuculus, Rhamphastus). Ardeidae und Charadriidae (Haematopus, Charadrius) sind zweifelhaft.

Während bei diesen Vögeln die Querfortsätze von *a* (und *b*) einen wesentlichen Anteil an der Befestigung des Beckens an das Kreuzbein haben, gibt es andere Vögel, bei denen nicht nur wie bei den schon genannten Hühnervögeln und Entenvögeln die betreffenden Querfortsätze eine geringe Bedeutung in dieser Beziehung haben, sondern bei denen diese Bedeutung fast zu 0 geworden ist. Ich führe einige Beispiele an. Bei *Cypselus* folgen hinter den Wirbeln des I. Abschnittes fünf Wirbel deren Querfortsätze sich sehr wenig von einander unterscheiden, alle sehr schwach sind, und unter denen es schwierig fällt diejenigen zu bezeichnen, die als *a* und *b* aufzufassen sind (die anderen gehören dem II. und IV. Abschnitt). Auch bei *Troglodytes* (Tab. 7, Fig. 6) habe ich Ähnliches gefunden. Bei *Cuculus* folgt hinter dem starken letzten Querfortsatz des I. Abschnittes eine ähnliche Reihe von fünf schwachen Querfortsätzen, von denen es kaum möglich ist zu sagen, welcher der Querfortsatz von *a* ist; es scheint der dritte zu sein. Noch unmöglicher erscheint es an einem vorliegenden Becken von *Picus major* zu sagen, welcher Querfortsatz der des *a* ist (vergl. Tab. 6, Fig. 9).

Der IV. Abschnitt zeichnet sich dadurch aus, dass die Reihe seiner Wirbelkörper — deren Zahl verschieden ist — mehr oder weniger nach unten gebogen ist, was eine Verstärkung dieses Kreuzbein-Abschnittes bedeutet. Die Querfortsätze der ersten dieser Wirbel besitzen gewöhnlich ziemlich lange aber schwache Querfortsätze, die mit einer schmalen Endfläche sich an den Ilium-Rand heften und für die Verbindung des Beckens mit der Wirbelsäule von untergeordneter Bedeutung sind; derartig finde ich die Verhältnisse z. B. bei den Tinamiden, den Hühnervögeln und den Lamellirostren. (Abweichungen siehe den speziellen Abschnitt.)

Anders verhalten sich aber die Querfortsätze der letzten 1—3 Wirbel dieses Abschnittes, welche Endpartie häufig stärker nach unten gebogen ist als das übrige. Diese Wirbel (Tab. 1, Fig. 8) tragen sehr starke Querfortsätze, deren Unterseite mit der platten Unterseite der Wirbelkörper in demselben Niveau liegt und deren Endfläche erweitert ist und sich mit dem hintersten Teil des Innenrandes des Ilium verbindet; an dieser Stelle fängt die starke Crista iliaca posterior an, die früher (p. 35) erwähnt ist, deren Existenz eben im nächsten Verhältniss zu der besonderen Entwicklung der genannten Wirbel steht. Diese Verbindung der letzten Kreuzbeinwirbel mit dem Ilium ist in manchen Fällen von grosser Bedeutung für den festen Aufbau des Gewölbes und in solchen Fällen treten die genannten Wirbel meist als etwas Besonderes im Vergleich mit den vorangehenden Wirbeln hervor. — Als Beispiele von Vögeln, bei denen diese Verbindung wohl ausgebildet ist — es gibt auch welche bei denen sie unbedeutend ist — nenne ich: das Huhn und verschiedene andere Hühnervögel, Corvus corax, Tagesraubvögel, Gruidae.

Ganz besonders entwickelt ist aber diese Verbindung bei den Ralliden (Tab. 7, Fig. 2 und Tab. 2, Fig. 9—10), derart dass man sofort ein Ralliden-Becken daran als solches erkennen kann. Die betreffenden Querfortsätze sind sehr hoch (ventro-dorsad), in einen dorsalen und einen ventralen Ast gespalten (der hinterste kann jedoch ungespalten sein); der dorsale Ast heftet sich an den Rand des Ilium, der ventrale an die stark hervorspringende Crista posterior (es ist ein stark ausgebildeter Recessus iliacus vorhanden). Die aufeinander folgenden Unterseiten der Fortsätze bilden zusammen mit der Unterseite der betreffenden Wirbel eine sehr augenfällige, hervortretende Fläche am Caudalende des Kreuzbeins; die Zahl der derartig ausgebildeten Wirbel ist bei Porphyrio (3 Ex. untersucht) zwei, bei Gallinula zwei oder drei (bei je 2 Ex.) bei Fulica atra drei oder vier.

6. Spezialbeschreibungen.

Die folgenden Seiten beanspruchen nicht das Thema zu erschöpfen; es sind lediglich anspruchslose Beobachtungen über das Verhalten des Kreuzbeins und des Beckens bei verschiedenen Vögeln, allen Hauptgruppen angehörig, die ich zu machen Gelegenheit gehabt habe und die ein Supplement zu den Abschnitten 1 und 3 bilden können.

a. Odontornithes.

Das Becken der Odontornithes habe ich nicht in natura untersuchen können, so dass die folgenden Bemerkungen auf den mustergültigen Figuren der Marsh'schen Monographie beruhen, die so zahlreich und gut sind, dass sie in grossem Masse die Objekte ersetzen.

Das Becken der Zahnvögel zeichnet sich ebenso wie das der Tinamiden und einiger Ratiten dadurch aus, dass die hinteren Enden von Ilium, Os ischii und Pubis nicht mit einander verbunden sind. Sie sind recht weit getrennt.

Bei keinem erreichen die oberen Ränder der Ossa ilium die Dornfortsätze des vorderen Kreuzbein-Abschnittes sondern sind etwas von denselben getrennt.

In der Ansicht von oben (Marsh, Plate 32, Fig 2) ist das Kreuzbein-Becken von *Ichthyornis* (und wahrscheinlich auch von *Apatornis*) im Ganzen dem der typischen Vögel ähnlich: in dem caudalen Teil liegt das Kreuzbein als eine breite von dem Becken nicht überdeckte Fläche zwischen den Ilium-Rändern. Bei *Hesperornis* sind dagegen die caudalen Teile der Ossa ilium in grosser Ausdehnung eng zusammengetreten (Marsh, Pl. 10, Fig. 2) ähnlich wie bei Apteryx und Rhea, und das Sacrum hier völlig überdeckt (natürlich ist hier nur von einer Analogie die Rede).

Der Processus praeacetabularis ist bei Hesperornis wohlentwickelt, bei den anderen fehlt er.

An dem (Marsh Pl. 32, Fig. 1) abgebildeten *Apatornis*-Becken ist der Processus inferior ischiadicus deutlich entwickelt, während derselbe an dem *Hesperornis*-Becken (ib. Pl. 11 Fig. 1) und scheinbar auch bei *Ichthyornis* (Pl. 34) fehlt.

An dem von Marsh (Pl. 32, Fig. 3) abgebildeten Becken und Sacrum von *Ichthyornis* sieht man ein Paar sehr lange quergestellte Querfortsätze, die offenbar einem Wirbel *a* angehören. Bei *Hesperornis* mit dem stark komprimierten Becken ist kein solcher langer Querfortsatz entwickelt, alle sind kurz, analog wie bei den Ratiten, Colymbus etc.

b. Tinamiden.

(Tab. 4, Fig. 7—8).

Bei allen Tinamiden sind Ilium und Os ischii, und letzteres und das Pubis hinten nicht mit einander verbunden. Zwischen den beiden ersteren ist der Abstand gross, während die letzteren einander ziemlich nahe liegen.

Am Pubis ist ein starker Processus praeacetabularis vorhanden (vergl. Boas 1929).

Die dorsalen Ränder der Ossa ilium erreichen nicht ganz die verwachsenen vorderen Dornfortsätze, die mit einem deutlichen niedrigen Grat sich bis an das Ende des Kreuzbeins fortsetzen.

Die Superficies infracristalis ist scharf ventrad resp. (bei *Crypturus*) etwas mediad gerichtet.

Die Querfortsätze des I. Abschnittes sind von mässiger Stärke.

Die ersten Querfortsätze des II. Abschnittes sind völlig verwischt (vergl. p. 40).

Der Querfortsatz des Wirbels *a* hat einen sehr starken Ventralast, der sich bis an das Acetabulum erstreckt und in ausgedehntem Mass mit dem Ilium verbunden ist (p. 41).

Dem Wirbel *b* fehlt dagegen bei *Rhynchotus* und *Crypturus* ein Ventralast. Bei der dritten untersuchten Gattung, *Notoprocta*, ist dagegen ein solcher Ventralast am *b* vorhanden, bei den drei untersuchten Exemplaren aber sehr ungleich entwickelt. Bei einem Exemplar ist derselbe rechts ungefähr ebenso stark wie der entsprechende von *a* und am peripheren Ende mit letzterem verwachsen; links ist er entschieden schwächer. Ähnlich verhält er sich beiderseits bei dem zweiten Exemplar. Bei dem dritten ist er eigentlich nur angedeutet, indem nur das mediale Ende verknöchert, das übrige nur durch einen dünnen (bindegewebigen oder knorpeligen) Strang vertreten ist.

Bei einem der untersuchten Crypturus-Exemplare, das wie gewöhnlich (vergl. Tab. 4, Fig. 7) im ganzen nur zwei starke ventrale Äste besitzt, gehört der rechte einem Wirbel an, der linke einem vorhergehenden, so dass es unsicher erscheint, welcher von diesen beiden Wirbeln als *a* in Anspruch genommen werden soll (Tab. 4, Fig. 8).

c. Ratiten.

(Tab. 7, Fig. 1; Tab. 8).

Sämtlichen Ratiten gemeinsam ist die starke Reduktion der *Superficies dorsalis* des Ilium, von welcher nur eine kleine dreieckige Fläche übrig geblieben ist, von deren lateraler Ecke sich ein Wulst ventrad nach dem Antitrochanter hin erstreckt. Die dreieckige Fläche setzt sich nur bei Struthio kenntlich caudalwärts mit einer schmalen Fläche fort, bei den anderen fällt die Fläche mit der Crista dorsolateralis zusammen. Bei Apteryx ist sogar die kleine dreieckige Fläche verschwunden, so dass das Ilium hier dorsal nur eine scharfe Kante besitzt. Um so stärker ist die Superficies infracristalis entwickelt. Sowohl diese wie die Superficies glutaea ist entschieden lateral gerichtet. Die dorsale Kante des Ilium ist in gewohnter Weise mit den Dornfortsätzen der Wirbel des I. Abschnittes verwachsen. Auch weiter hinten verwachsen in der

Regel die dorsalen Enden der Dornfortsätze mit den Ilium-Rändern (bei Struthio bleiben sie aber grösstenteils frei).

Bei *Struthio* (Tab. 7, Fig. 1) und bei *Apteryx* sind das Os ilium und das Os ischii caudal nicht mit einander verwachsen, verhalten sich also wie bei den Tinamiden und den Odontornithes. Bei Casuarius, Dromaeus und Rhea (Tab. 8) ist dagegen das caudale Ende des Ilium mit dem Os ischii verwachsen, jedoch nur die Endpartie, nicht wie bei den Carinaten der ventrale Ilium-Rand in grosser Ausdehnung; bei Casuarius und Dromaeus ist es das caudale Ende des Os ischii, das sich mit dem Ilium-Ende verbindet, bei Rhea (Tab. 8, Fig. 2) dagegen heftet das Ilium-Ende sich an das Os ischii weit vor dem Caudalende des letzteren. Bei allen Ratiten ist das Ende des Os ischii mit dem Pubis verwachsen, d. h. der Knorpel des einen setzt sich direkt in den Knorpel des anderen fort und schliesslich verknöchert diese Verbindung. Bei Struthio ist das Ende des Os ischii mit dem Pubis an einer Stelle weit vor dem Caudalende des Pubis verbunden; bei den anderen findet die Verbindung aber an den Caudalenden beider Knochen statt. Das Foramen obturatorium ist im Gegensatz zu dem der Tinamiden sehr breit.

Den Ratiten charakteristisch ist es, dass die Dornfortsätze nicht allein des I. Abschnittes sondern auch — im Gegensatz zu den meisten Vögeln[1]) — der folgenden von ansehnlicher Höhe sind (Tab. 8, Fig. 1). Auch die hinteren sind sozusagen eingeklemmt zwischen den Ossa ilium, am ausgeprägtesten bei Apteryx, Dromaeus und Casuarius, etwas weniger bei Rhea und Struthio.

Verschiedene Charaktere der Ratiten-Becken sind so allgemein bekannt, dass es überflüssig erscheint, sie hier zu nennen.

d. Rasores.

(Tab. 1; Tab. 2, Fig. 4; Tab. 4, Fig. 1; Tab. 10).

Das hier behandelte Material von Hühnervögeln umfasst zwei Craciden (Crax alector, Mitua mitu), eine grosse Anzahl Gallus domesticus, 6 Pavo, 2 Meleagris, Phasianus, Perdix, Francolinus, 2 Tetrao urogallus.

Die gewöhnliche Zahl der Wirbel des I. Abschnittes ist 4, von denen der erste eine Rippe trägt; es können aber auch 5 Wirbel vorhanden sein. Häufig ist der Wirbel β mit einem Ventralast versehen, der sehr verschieden stark ausgebildet sein kann: 1. nur als eine Andeutung (nur teilweise verknöchert: Crax), 2. stärker, aber immerhin viel schwächer als der von α (Mitua), 3. dem von α an Stärke sich nähernd.

Am II. Abschnitt ist sehr häufig am Querfortsatz des Wirbels 1_{II} ein Ventralast vorhanden, der bald schwach, nur teilweise verknöchert, bald recht stark sein kann.

Am III. Abschnitt ist der Ventralast des Wirbels *b* fast immer schwach entwickelt, nur wenig oder gar nicht stärker als der des folgenden Wirbels, *c*, meist ist jedoch trotzdem dieser Ventralast durch ein Loch vom Dorsalast gesondert. — Bei den untersuchten Craciden ist der Ventralast von *a* stark und erreicht mit seinem erweiterten Ende

[1]) Bei Hesperornis — nicht aber bei Ichthyornis und Apatornis — sind die hinteren Kreuzbeinwirbel ebenfalls mit recht grossen Dornfortsätzen versehen.

das Acetabulum. Bei den übrigen untersuchten ist letzteres nie der Fall: die Anheftungsstelle ist stets weit von dem Acetabulum entfernt. Meistens ist dieser Ventralast auch schwach — am stärksten habe ich ihn bei Pavo gefunden —, wenn auch meistens kenntlich stärker als der von *b*.

Als seltene Ausnahme habe ich bei einem jungen Gallus domesticus gefunden, dass der Ventralast von *a* auf der linken Seite schwach, nur teilweise verknöchert war, und dass dafür der nachfolgende Ventralast, der von *b*, um so stärker entwickelt und mit breiter Ansatzfläche (Distalende) ausgestattet ist; auf der rechten Seite ist der Ventralast von *a* von fast normaler Stärke. — Bei einem anderen Exemplar sind die Ventraläste *a* und *b* auf der linken Seite wie bei dem soeben beschriebenen entwickelt, aber auch auf der rechten Seite ist der Ventralast von *a* rückgebildet, indem er nur von einem dünnen Knochenbalken vertreten ist, der weit schwächer ist als der starke Ventralast von *b*.

Der IV. Abschnitt ist meist ziemlich gerade, nur wenig gebogen, die hintersten (meistens zwei) Wirbel wie gewöhnlich stärker als die vorhergehenden und mit dem Ende des Ilium verbunden. Abweichend von dem gewöhnlichen Verhalten ist der IV. Abschnitt bei dem männlichen *Pavo* recht stark abwärts gebogen und somit im Vergleich mit dem der übrigen gestärkt. Dasselbe finde ich auch bei einem *Chrysolophus*, und vielleicht ist das überhaupt mit den mit besonders schweren Schwanzfedern ausgestatteten Rasores der Fall.

Was das Becken selbst betrifft, so ist das in typischer Weise ausgebildet: die Superficies dorsalis ist von ansehnlicher Breite, die deutlich entwickelte Superficies infracristalis von jener durch eine stark oder recht stark hervortretende Crista dorsolateralis getrennt. Der Proc. praeacetabularis ist bei manchen stark (am schwächsten fand ich ihn bei Tetrao, Lagopus und Mitua). Der Recessus iliacus ist meist recht tief, am seichtesten ist er bei Tetrao und Lagopus. Das Pubis liegt dem Os ischii nahe an und ist bei manchen (z. B. Gallus) eine längere Strecke hinter dem Foramen dissaeptum mit dem Os ischii verwachsen. — Eigenartig ist die breite offene Form des Kreuzbein-Beckens bei *Lagopus* (Tab. 4, Fig. 1) und etwas weniger ausgeprägt bei Tetrao.

e. Laridae.

(Tab. 5, Fig. 4—6, Tab. 2, Fig. 14).

Am III. Abschnitt hat der Querfortsatz von *a* durchweg (Tab. 5, Fig. 4) einen langen starken Ventralast, der meist scharf quer gerichtet ist und sich manchmal bis dicht an das Acetabulum erstreckt. Das Loch zwischen demselben und dem Dorsalast ist mässig gross; bei der einzigen untersuchten Sterna cantiaca ist es auf der rechten Seite klein, auf der linken Seite sogar ganz geschlossen. An *b* fehlt bei Larus durchweg ein Ventralast, und der Dorsalast ist nicht stärker oder gar schwächer als an *c*; nur an einem Larus canus ist ein dünner aber wohl ausgebildeter Ventralast an *b* vorhanden, der durch ein ziemliches Loch von dem Dorsalast geschieden, der als eine scharfe dünne Kante hervortritt; bei einem anderen Larus canus fehlt der Ventralast, der Dorsalast ist aber ähnlich geformt. — Bei einer Sterna hirundo Tab. 5, Fig. 5, fehlt der Ventralast an der rechten Seite von *a*, dagegen ist ein starker Ventralast an derselben Seite von *b* vorhanden (an der linken Seite von *b* ist eine Andeutung des proximalen Endes des Ventralastes zu bemerken). Bei einer Sterna minuta, Tab. 5, Fig. 6, ist auf der linken Seite sowohl auf *a* wie *b* ein Ventralast (stark an *a*, dünn an *b*) vorhanden, während auf der rechten Seite nur an *b* ein (starker) Ventralast ausgebildet ist, während auf dieser Seite ein Ventralast an *a* fehlt.

Bei drei von den sechs untersuchten Sterna-Exemplaren und bei zwei von den untersuchten Larus (ridibundus, canus) liegt der vorderste Kreuzbeinwirbel ganz vor dem Ilium.

Das Becken selbst hat die typische Form. Das Os ischii hat einen spitzen ausgezogenen, meist nicht sehr scharf abgesetzten Processus terminalis, der sich dem Pubis-Rand anlegt und das recht breite Foramen obturatorium caudal abgrenzt. Der Processus inf. ischiad. ist caudal nicht vom unteren scharfen Rand des Os ischii abgesetzt.

Von den Cristae auf der Unterseite des Ilium (Tab. 2, Fig. 14) ist die *Crista obliqua* ungemein deutlich und liegt innerhalb des Ilium-Randes, fliesst nicht mit diesem zusammen. Vor derselben ist noch eine schwache Crista vorhanden, an deren Ende der Querfortsatz des Wirbels β sich ähnlich anheftet wie der von α an die Crista obliqua. Die *Crista intermedia* ist ebenfalls sehr deutlich. Dagegen ist die *Crista posterior* namentlich bei Sterna sehr schwach und der Recessus iliacus selbst bei den Larus-Arten stets unbedeutend; bei Sterna kann man von einem Recessus nicht reden.

Bei sämmtlichen vorliegenden Becken von Sterna erreichen die dorsalen Ilium-Ränder nicht den Dornfortsatz-Kamm, während sie bei allen vorliegenden Larus-Becken (auch bei den kleinen Arten) mit demselben verwachsen sind.

f. Steganopodes.

Von den hier untersuchten Steganopoden: Pelecanus, Graculus, Plotus, Sula lässt sich von dem Kreuzbein-Becken nur wenig gemeinschaftliches sagen, weshalb wir die Formen getrennt behandeln.

Pelecanus. Das eigenartige Verhalten der ersten Wirbel des I. Abschnittes von Pelecanus ist schon früher (p. 15) erwähnt worden.

Von den drei vorliegenden Pelecanus-Becken hat eines 4, die andern 3 Wirbel im II. Abschnitt. Das erste hat am 1_{II} einen ziemlich dünnen Ventralast; bei dem einen der dreiwirbeligen ist ebenfalls an demselben Wirbel ein Ventralast entwickelt, der aber noch dünner und nur teilweise verknöchert ist; an dem dritten Exemplar fehlt ein solcher Ventralast.

Die Wirbel *a* und *b* (III. Abschnitt) haben beide wohlentwickelte Ventraläste, die am distalen Ende verwachsen sind und sich dicht bei (hinter) dem Acetabulum mit dem Ilium verbinden; bei einem Exemplar ist der linke Ventralast von *a* stark verdünnt, dafür aber ist der linke Ventralast von *b* stärker als gewöhnlich, sonst ist der von *b* schwächer als der von *a*, aber immerhin recht stark. Auch die folgenden Wirbel (IV. Abschnitt), *c*, *d*, *e*, (*f*) haben wohlentwickelte Ventraläste, die durch ein Loch vom Dorsalast getrennt sind. Der letzte Wirbel des IV. Abschnittes ist wie gewöhnlich mit recht starken Querfortsätzen ausgestattet, die mit dem Ilium verwachsen.

Was das Becken selbst betrifft, so ist die Superficies dorsalis wohl entwickelt und von der nicht sehr breiten Sup. infracristalis durch eine nicht scharfe Crista dorsolateralis getrennt. Der Proc. praeacetab. fehlt. Das Foramen obturatorium ist ziemlich breit.

Sula. Bei allen vier vorliegenden Sula-Becken liegt der vorderste Wirbel des I. Abschnittes vor dem Ilium.

Im II. Abschnitt sind nur 2 oder 3 Wirbel vorhanden.

Im III. Abschnitt haben die zwei Exemplare nur an *a* einen Ventralast, die beiden anderen dagegen ähnlich wie Pelecanus sowohl an *a* wie an *b* einen; bei dem einen Exemplar ist der von *b* ebenso stark wie der von *a*; sie heften sich an das Ilium in derselben Weise wir bei Pelecanus.

Die Querfortsätze des IV. Abschnittes sind kurz und stark, namentlich nach hinten zu, aber nicht durchbohrt (also ohne gesonderten Ventralast).

Das Becken ist in seiner caudalen Hälfte wesentlich schmäler als beim Pelecanus. Die Superficies dorsalis ist schmäler und eine Crista dorso-lateralis kaum angedeutet. Auch der Proc. praeacetab. ist fast verwischt. Das Foramen obturat. ist deutlich aber etwas schmäler als bei Pelecanus.

Graculus (Phalacrocorax) und *Plotus*. Bei zwei der vorliegenden vier Graculus-Becken und bei dem einzigen von Plotus liegt der vorderste Kreuzbein-Wirbel vor dem Ilium.

Bei sämtlichen Stücken von Graculus und Plotus sind nur 2 Wirbel im II. Abschnitt vorhanden. Bei zwei Graculus und bei Plotus ist an dem ersten dieser Wirbel jederseits ein ziemlich starker Ventralast vorhanden.

An dem Wirbel *a* ist stets ein starker Ventralast vorhanden, der sich hinter dem Acetabulum mit dem Ilium verbindet. Am *b* fehlt gewöhnlich ein Ventralast; nur bei einem Graculus und bei Plotus ist ein schwacher, bei Plotus fadendünner Ventralast auf der einen Seite vorhanden.

Im IV. Abschnitt sind bei Graculus nicht weniger als 7 Wirbel vorhanden, die alle mit kurzen starken Querfortsätzen (nur Dorsaläste), die am distalen Ende mit dem Ilium verwachsen, versehen sind, bei Plotus dagegen nur 5, von den die 4 ersten mit dem Ilium an ihrem distalen Ende verwachsen sind.

Die caudale Hälfte des Beckens ist schmal, die Superficies dorsalis ist stark rückgebildet, besonders bei Graculus, die Crista, besonders bei Plotus, stark hervortretend. Der Proc. praeacetab. ist wenig hervortretend. Der Proc. terminalis ischiad. ist sehr breit. Das Foramen obturat. ist ziemlich breit.

Auf der Unter-(Innen-)seite des Os ischii ist ein starker scharfer Längskamm vorhanden, der auch bei Pelecanus und Sula deutlich hervortritt (auch bei manchen anderen Vögeln bemerkbar, aber schwächer).

g. Colymbiden.

(Tab. 2, Fig. 11—12, Tab. 3, Fig. 1.)

Untersucht wurden *Colymbus arcticus* und Colymbus sp. und mehrere Arten von *Podicipes*.

Sehr charakteristisch ist die extreme Schmalheit des Kreuzbeins, dessen Querfortsätze ganz kurz sind, bei Podicipes sogar derart, dass die Querfortsätze des IV. Abschnittes nur durch grosse rauhige Flächen an den Seiten der betreffenden Wirbel vertreten sind. Die längsten Querfortsätze sind die der vordersten Wirbel des I. Abschnittes. Die gewöhnlichen Abteilungen des Kreuzbeins sind vorhanden. Es ist nicht richtig, wenn Gegenbaur (l. c. p. 178) schreibt, dass »Bei der Enge der Pfannengegend sind auch keine acetabularen Wirbel [d. h. *a* und *b*] unterscheidbar«; namentlich bei Colymbus sind die Wirbel *a* und *b* sehr deutlich von den anderen unterscheidbar; *a* ist deutlich mit einem jedenfalls bei einigen Exemplaren gesonderten kleinen Ventralast versehen und auch der Ventralast des Querfortsatzes von *b* ist klar angedeutet. Man sieht das allerdings nur an Präparaten, an denen die eigentlichen Beckenhälften von dem Kreuzbein durch Mazeration abgelöst sind (die Beckenhälften bleiben zeitlebens frei).

Die Querfortsätze des III. u. IV. Abschnittes sind sehr stark und verbinden sich mit dem Ilium durch eine grosse Ansatzfläche und dasselbe ist namentlich bei Colymbus auch mit den fast ausgeebneten Querfortsätzen des II. Abschnittes der Fall.

Die Verschmälerung der vorderen Partie des Ilium ist bereits früher (p. 37) erwähnt sowie die dadurch entstandene Freilegung des von den verschmolzenen Dornfortsätzen des I. Abschnittes gebildeten starken Kammes. Von einer gesonderten Superficies dorsalis kann man hier nicht reden; dieselbe bildet mit der Sup. infracrist. eine schräg abwärts gerichtete Fläche; die Crista dorso-lateralis fehlt. Bei einem der untersuchten Colymbus ist der Proc. praeacetab. sehr deutlich, bei den anderen und bei Podicipes nur spurweise vorhanden. Von dem Recessus iliacus oder der Crista iliac. post. ist keine Spur vorhanden. Der Proc. inf. ischiad. ist besonders bei Podicipes deutlich. Der Proc. terminalis isch. ist bei Colymbus wohlentwickelt (Tab. 2, Fig. 11) und deutlich markiert; bei Podicipes läuft das Os ischii in eine einfache Spitze aus. Das Foramen obtur. ist eine breite Spalte.

h. Alcidae.

Alca, Mormon, Uria, Mergulus.

(Tab. 2, Fig. 5; Tab. 10, Fig. 7).

Charakteristisch für die Alciden ist es, dass das Kreuzbein von der Dorsalseite gesehen an seinem Hinterende ebenso breit oder breiter ist als die sonst erweiterte Stelle zwischen den Acetabula, während es bei den meisten Vögeln gegen das Hinterende zu etwas schmäler wird. — Der Ventralast des Querfortsatzes von *a* ist wenig hervortretend und nicht von dem Dorsalast getrennt; sein Ende heftet sich fast nur an den Ilium-Rand, weit vom Acetabulum. Noch schwächer ist meist der von *b*; nur bei dem einzigen untersuchten Mormon habe ich ihn stärker (fast ebenso stark wie den von *a*) gefunden. Die beiden letzten Querfortsätze des IV. Abschnittes sind stark und heften sich mit einer grossen Fläche an das Ilium (Tab. 2, Fig. 5).

Bei zwei Uria und zwei Mergulus sowie bei Mormon ist am 1_{II} ein dünner Ventralast der Querfortsatzes vorhanden; der vor demselben liegende Ventralast des Wirbels *α* ist bei den meisten derselben sehr stark. Den genannten Ventralast des Wirbels 1_{II} habe ich bei allen vorliegenden (6) Exemplaren von Alca wiedergefunden, bei welcher er meist stärker ist als bei den anderen, bisweilen fast ebenso stark wie der von *α*. Dass der Wirbel, der den betreffenden Ventralast trägt, wirklich 1_{II} ist, habe ich durch Untersuchung der Nerven einer Alca konstatiert (Tab. 10, Fig. 7): der Nerv *1 i* tritt vor demselben mit der letzten *cruralis*-Wurzel zusammèn hinaus; die Verhältnisse liegen ganz typisch abgesehen von dem Vorhandensein des Ventralastes am 1_{II}.

Die Superficies dorsalis ist deutlich entwickelt und die Crista dorso-lateralis jedenfalls erkennbar. Die Crista intermedia ist recht wohl entwickelt, die Crista iliaca post. ist mehr oder weniger deutlich, von einem Recessus ist aber keine Rede. Von dem Proc. praeacet. ist nur eine Spur vorhanden. Das Os ischii endigt in eine Spitze, das Pubis ist nicht weit von dem Os ischii entfernt. Die Beckenhälften verwachsen meistens nicht mit dem Kreuzbein; nur bei einer Uria troile habe ich eine ausgedehntere Verwachsung gefunden (bei Mormon ist nur ganz vorne eine begrenzte Verwachsung eingetreten).

i. Sphenisciden.

Spheniscus demersus (Brillenpinguin) u. Pygoscelis papua.

(Tab. 2, Fig. 7; Tab. 10, Fig. 6).

Die Querfortsätze von *a* und *b* sind wenig hervortretend. Trotzdem spielen sie offenbar hier eine sehr wesentliche Rolle als Becken-Träger. Die betreffenden Querfortsätze sind kurz und stark; von einer Sonderung eines Ventral- und Dorsalastes ist nicht die Rede. An zwei Becken von Spheniscus demersus, an denen das Kreuzbein durch Mazeration von den Beckenhälften getrennt ist (Tab. 2, Fig. 7), bilden die vereinigten Endflächen der Querfortsätze von *a* und *b* eine grosse rauhe Fläche, die grösstenteils dorsad gerichtet ist, so dass das Ilium auf derselben ruhen kann; diese Fläche hängt mit den Endflächen der Querfortsätze von den beiden letzten Wirbeln des Abschnittes II zusammen; dieser Teil der gemeinsamen Anheftungsfläche ist aber seitlich oder etwas ventral gerichtet.

Bei der Mehrzahl der untersuchten Brillenpinguine findet sich an den 1_{II} ein sehr starker Ventralast des Querfortsatzes (Tab. 10, Fig. 6), der den voranliegenden von *α* sehr ähnlich ist (bei beiden ist übrigens der Ventralast nicht von dem Dorsalast getrennt). Es könnte somit fraglich sein, ob der betreffende Wirbel wirklich 1_{II} und nicht etwa *α* sei. Eine Untersuchung der Nerven zeigt aber, dass der Nerv *1 i*, mit dem *1 c* zusammen, vor dem betreffenden Querfortsatz heraustritt, so dass der betreffende Wirbel nicht dem I. Abschnitt angehören kann.

Die letzten Querfortsätze des Abschn. IV sind relativ schwach, nicht besonders als Beckenträger ausgebildet.

Der Proc. praeacetabularis ist fast gänzlich verwischt.

Die Crista dorsolateralis ist sehr scharf, und die Superficies dorsalis des Ilium liegt nicht wie gewöhnlich horizontal zur Längsachse sondern steht fast senkrecht oder schräg. Der Processus ilio-lateralis ist scharf hervortretend.

Das Pubis liegt dem Unterrand des Os ischii eng an (ohne mit ihm verwachsen zu sein), so dass das Foramen obturatorium in seiner ganzen Länge geschlossen ist, natürlich mit Ausnahme der Pars dissaepta.

Die medianen Ränder der Ossa ilium erreichen nicht den Dornfortsatz-Kamm. Am weitesten entfernt sind sie bei *Pygoscelis papua,* bei der der vordere Abschnitt des Ilium eine fast wagerechte Platte ist, während derselbe bei Spheniscus etwas schräger steht und auch nicht so weit von dem Kamm entfernt ist.

Beim Brillenpinguin bleiben die Beckenhälften selbständig, verwachsen nicht mit dem Kreuzbein. Bei Pygoscelis sind dagegen die meisten Querfortsätze mit dem Becken verwachsen.

j. Lamellirostres.

(Tab 2, Fig, 8; Tab. 3, Fig. 5—6; Tab. 5, Fig. 7—9; Tab. 13; Textfigg. 28—30, p. 29).

Charakteristisch und ungewöhnlich ist es, dass fast immer wenigstens drei rippentragende Wirbel in das Sacrum aufgenommen sind, bisweilen sogar 4 oder 5. Charakteristisch ist auch die grosse Wirbelzahl in dem langen, geraden IV. Abschnitt, wenigstens 5, sehr häufig 6, bisweilen 7, 8 oder 9. Meist ist dieser Abschnitt jedoch recht schwach, er trägt nur wenig zum Tragen des Beckens bei und die Endflächen der letzten Querfortsätze sind schmal (Tab. 2, Fig. 8). Selbst bei alten Tieren sind die Enden der Querfortsätze dieses Abschnittes nicht mit dem Ilium verwachsen. Die Ventraläste der Querfortsätze von *a* und *b* sind nicht besonders stark (Tab. 5, Fig. 7—9), der von *a* oft wesentlich stärker als der von *b*; der Querfortsatz von *b* ist zuweilen nicht stärker als der von *c* und ein Ventralast dann eventuell nicht durch ein Loch abgetrennt. Die Anheftungsfläche des Querfortsatzes von *a* erstreckt sich nicht weit auf das Ilium hinauf. (Über den Ventralast von 1_{II} ist schon vorhin gesprochen, p. 27.)

Die Beckenhälften sind gestreckt, besonders die Partien hinter dem Acetabulum. Der Proc. praeacetabularis ist recht wohlentwickelt. Die Crista iliaca posterior ist entweder fast nur angedeutet oder gänzlich verwischt, von einem Recessus iliacus ist somit keine Rede. Der Process. terminalis ischiadicus ist wohl abgesetzt, beilförmig, und das Foramen obturatorium breit und offen. Die Crista dorsolateralis ist fast verwischt und die Superficies dorsalis des Ilium stark rückgebildet.

Anhang an die Lamellirostres:

Phoenicopterus, Palamedeidae (*Chauna*).

Das Sacrum von *Phoenicopterus* weicht dadurch von dem der Lamellirostres ab, dass der Ventralast des Querfortsatzes von *a* bedeutend stärker ist und sich dicht beim Acetabulum an das Ilium heftet und somit offenbar eine bedeutendere Rolle spielt als Träger des Beckens als bei jenen. Der Abschnitt IV ist kürzer als bei den Lamellirostren. — An den Beckenhälften ist die Crista dorso-lateralis markierter und die Superficies dorsalis ganz wohl ausgebildet. Der Proc. praeacetabularis fehlt. Der Proc. terminalis ischiadicus ist nur angedeutet und verbindet sich nicht mit dem Pubis, so dass das Foram. obturat. caudal offen ist. Von rippentragenden Wirbeln ist im Sacrum nur 1 oder 2 vorhanden.

Im Ganzen muss man sagen, dass die Verhältnisse des Beckens und des Sacrum nicht den Gedanken einer näheren Verwandtschaft des Phoenicopterus mit den Lamellirostren stützt.

Chauna. Auch bei Chauna ist der Ventralast von *a* stärker als bei den Lamellirostren, erstreckt sich jedoch nicht so weit nach dem Acetabulum hin wie bei Phoenicopterus. Der Abschnitt IV ist kurz. — Die Crista dorso-lateralis und die Superficies dorsalis verhalten sich wie bei Phoenicopterus. Der Recessus iliacus (der bei Phoenicopterus fast verwischt ist) ist hier deutlich, wenn auch nicht tief. Der Proc. praeacetabularis fehlt auch bei Chauna. Der Proc. terminalis ischiad. verhält sich ungefähr wie bei Phoenicopterus.

Becken und Sacrum von Chauna schliessen sich somit eher an die von Phoenicopterus als an die der Lamellirostres an, und für den Gedanken eines näheren Anschlusses der Palamedeiden an die Lamellirostres geben das Becken und Kreuzbein keine Stütze ab.

k. Ardeidae.

(Tab. 12, Fig. 4—5).

Der Ventralast von *a*, der nicht besonders stark ist, heftet sich an das Ilium ziemlich weit von dem Acetabulum. Der Ventralast von *b* ist ihm ähnlich, nur etwas kürzer. Auch der von *c* reiht sich diesen Wirbeln an. Der Abschnitt IV ist kurz, die Querfortsätze aber stark und mit dem Ilium verwachsen, so dass sie wesentlich zur Stärke der Verbindung des Sacrum mit dem Becken beitragen. In Vergleich mit Ardea zeichnet Botaurus stellaris sich durch die Kürze der Querfortsätze der Wirbel des III. und IV. Abschnittes aus.

Die Crista dorso-lateralis ist sehr scharf und hervortretend und die Superficies dorsalis ist sehr wohl entwickelt. Sehr eigentümlich ist es, dass das Os ischii caudad mit einem knorpeligen Processus terminalis endet, der sich an das Pubis heftet (also eine neotenische Erscheinung). Das Foramen obturatorium ist recht breit. Ein Proc. praeacetabularis fehlt. Es ist ein bei Ardea (cinerea) seichter aber deutlicher, bei Botaurus stellaris tieferer Recessus iliacus vorhanden.

l. Ciconiidae.

(Tab. 4, Fig. 2—6).

Bei sämtlichen untersuchten Ciconiiden (Ciconia, Leptoptilus, Dissoura, Platalea) erstreckt sich der quer gerichtete recht starke Ventralast von *a* bis an das Acetabulum. Der Ventralast von *b* ist bei Ciconia und Platalea meistens viel schwächer als der von *a*; bei Leptoptilus und Dissoura ist er stärker als bei den genannten, wenn auch schwächer als der von *a*. Der Ventralast von *c* ist durchweg nicht viel schwächer als der von *b*.

Die Störche haben denselben knorpeligen Proc. terminalis ischiad. wie die Ardeiden. Auch die Crista dorso-lat., die Superficies dorsalis und der Proc. praeacetab. verhalten sich ebenso. Der Recessus iliacus ist deutlich bei Ciconia und Platalea, fast verwischt bei Leptoptilus und Dissoura. Der Proc. iliolateralis, der bei den Ardeiden fehlt, ist wohlentwickelt.

Im Ganzen sind die Ardeiden und Ciconiiden, die sich ja sonst vielfach unterscheiden, im Becken recht ähnlich. Namentlich der gemeinsame knorpelige Proc. terminalis scheint mir charakteristisch.

m. Otididae.

Von dieser Familie habe ich nur ein (altes) Exemplar von *Otis tarda* untersucht.

Das Sacrum ist dem der Ardeiden ähnlich: Der Ventralast von *a* erreicht nicht das Acetabulum und ist nicht besonders stark. Der von *b* ist schwächer als bei den Ardeiden, tritt gegen den von *a* wesentlich zurück und ist kaum stärker als der von *c*. Die letzten Querfortsätze des Abschn. IV sind ebenso wie bei den Ardeiden stark und fest mit dem Ilium verbunden.

Für das Becken gilt die Beschreibung von den Ardeiden fast genau (Crista dorso-lat., Superficies dorsalis). Es ist ein deutlicher Recessus iliacus vorhanden.

n. Charadriidae.

(Tab. 2, Fig. 13).

Am Wirbel *b* fehlt bei der Mehrzahl der untersuchten der Ventralast, dagegen ist derselbe an *a* stark und quer gerichtet; die Anheftung desselben enstreckt sich nicht bis an das Acetabulum.

Die Crista dorso-lateralis ist scharf, die Superficies dorsalis wohlentwickelt, was auch von dem Proc. iliolateralis gilt. Der Proc. terminalis ischiad. heftet sich mit einem ziemlich langen Rand an das Pubis. Das Foram. obtur. ist recht breit. Ein Recessus iliacus fehlt, die Crista iliaca post. ist eben nur angedeutet. Ein Proc. praeacetab. fehlt (oder ist eben angedeutet).

o. Scolopacidae.

(Tab. 6, Fig. 11—12; Tab. 7, Fig. 3—4).

Noch häufiger als bei den Charadriidae fehlt an *b* der Ventralast; nur bei einem Scolopax-Exemplar habe ich einen solchen gefunden. Der Ventralast von *a* ist quer gerichtet und seine Anheftungsfläche am Ilium erstreckt sich bis an das Acetabulum.

Die Crista dorso-lateralis ist meist scharf, der Processus iliolateralis wohlentwickelt, ebenso die Superficies dorsalis. Der Proc. terminalis ischiad. verhält sich ebenfalls wie bei den Charadriiden. Der Proc. inf. ischiad. verbindet sich bei Scolopax und Tringa durch knöcherne Verwachsung mit dem Pubis; dagegen ist das nicht bei Totanus, Numenius, Limosa und Recurvirostra der Fall. Das Foramen obturatorium ist eine deutliche offene, nur hinten geschlossene Spalte. Der Recessus iliacus ist bei Scolopax rusticola eine deutliche Grube und die Crista iliaca post. eine scharfe Kante; bei den anderen untersuchten (Recurvirostra, Limosa, Numenius, Tringa, Totanus) ist der Recessus rückgebildet und die Crista schwach. Ein Proc. praeacetabularis ist bei Scolopax rusticola und Totanus glottis deutlich, bei den anderen nur angedeutet.

p. Rallidae.

(Tab. 2, Fig. 9—10; Tab. 7, Fig. 2).

Die hervorragendste Eigentümlichkeit des Sacrum der Ralliden ist die eigenartige Ausbildung der letzten Wirbel des IV. Abschnittes, deren Querfortsätze als kräftige Träger des caudalen Endes der Beckenhälften ausgebildet sind (wie bereits p. 17 beschrieben wurde). Der Ventralast des Wirbels *a* ist wohlausgebildet und das distale Ende desselben mit dem Ende des Querfortsatzes von *b* (der meist nicht in Dorsal- und Ventralast gespalten ist) verwachsen; er heftet sich an das Ilium ziemlich nahe dem Acetabulum. Bei einem der vorliegenden Exemplare von Porphyrio hat der letzte Wirbel des Abschnittes II einen ähnlichen Ventralast wie *a* und das Ende desselben ist mit letzterem verwachsen. Bei einem anderen Exemplar von Porphyrio ist der Ventralast von *a* dünn und auf der rechten Seite unterbrochen, und der von *b* ist hier gesondert und stärker als der von *a*.

Eigentümlich ist die ansehnliche Länge des I. Abschnittes des Sacrum und des vorderen Teiles des Beckens. Der hintere Teil der deutlichen Crista dorso-lateralis ist fast dachförmig und mit einem grossen Proc. iliolateralis ausgestattet; die Superficies dorsalis ist wohlentwickelt. Entsprechend der eigenartigen Entwicklung der hinteren Querfortsätze ist der Recessus iliacus ganz mächtig entwickelt; an den dorsalen Rand derselben heften sich die Dorsaläste der Wirbel, an den ventralen Rand die Ventraläste. Es ist ein deutlicher Proc. praeacetabularis vorhanden. Der Proc. terminalis ischiad. ist wohlentwickelt und heftet sich an ein Fortsätzchen am dorsalen Rand des Pubis. Das Foram. obtur. ist deutlich.

q. Gruidae.

(Tab. 2, Fig. 2).

Der Ventralast ist sowohl am *a* wie am *b* stark und sie vereinigen sich distal mit einander und verwachsen mit dem Ilium dicht am Acetabulum. Mit dem Ventralast von *b* verbindet sich bei mehreren auch der recht wohl entwickelte Ventralast von *c*. Die letzten zwei oder drei Wirbel vom Abschn. IV haben starke Querfortsätze, die mit dem Ilium verwachsen.

Die Crista dorso-lateralis ist in der Regel scharf, der Proc. ileolateralis deutlich, die Superficies dorsalis bei den eigentlichen Kranichen wohlentwickelt, bei Dicholophus verschmälert. Der Recessus iliacus ist bei Grus eine wohlentwickelte Grube, bei Dicholophus ist er sackförmig vertieft, sehr stark. Während das sehr dünne Pubis von Dicholophus sich dem Os ischii dicht anschmiegt, so dass vom Foramen obtur. nur die Pars dissaepta offen bleibt, berührt bei Grus das Pubis — das recht stark ist — gar nicht das Os ischii, auch nicht am Hinterende, das Foramen ist breit und hinten offen.

r. Rapaces.

(Tab. 2, Fig. 3; Tab. 6, Fig. 1—8).

Von Raubvögeln habe ich — z. T. zahlreiche — Repräsentanten aller vier Unterabteilungen: Tagraubvögel, Ostgeier, Westgeier und Eulen untersucht.

Sämtlichen Raubvögeln charakteristisch ist die Verkürzung des caudalen Teiles des Sacrum, indem der III. und IV. Abschnitt zusammen meist nur aus 4 oder 5 Wirbeln zusammengesetzt sind (nur bei einem Exemplar von Sarcorhamphus fand ich 6 Wirbel). Der betreffende Teil des Sacrum ist auch dadurch ausgezeichnet, dass er mehr als sonst bei den Vögeln abwärts gebogen ist; am wenigsten ist dies wohl bei den West-Geiern ausgeprägt. Die Querfortsätze der zwei letzten Wirbel, oder allein des letzten, heften sich mit einer breiten Endfläche an den Ilium-Rand. Die recht starken Querfortsätze von *a* und *b* heften sich an das Ilium bis nahe an das Acetabulum. Die Verbindung zwischen Sacrum und Becken am caudalen Ende des Beckens ist durch diese verschiedenen Verhältnisse eine sehr innige, die Partie eine ausserordentlich starke.

An den Beckenhälften ist als besonders charakterisch hervorzuheben die stark schräge Richtung ventrad des hinteren Teils des Ilium und des Os ischii (Tab. 2, Fig. 3). Bei einigen, z. B. Aquila chrysaëtus, ist diese Biegung so stark, dass das ganze Becken zusammengeknickt erscheint. Etwas weniger stark, aber doch sehr augenfällig ist die Biegung bei anderen Tagraubvögeln[1]) und bei den Ostgeiern, wieder etwas weniger bei den Westgeiern und den Eulen, überall aber sehr deutlich.

Die Crista dorso-lateralis ist stets deutlich, bei den Eulen stark hervortretend (am stärksten bei Nyctea nivea); die Superficies dorsalis ist wohlentwickelt. Die Crista iliaca post. ist stark hervortretend, der Recessus iliacus meist eine recht markierte Grube, nur bei den Ostgeiern verflacht; bei den Tagraubvögeln und den Ostgeiern erstreckt sich aber das Foramen ilio-ischiadicum bei der Kürze des hinteren Teiles des Beckens so weit caudad, dass die Grube laterad ganz offen ist; bei den Westgeiern und den Eulen ist immerhin etwas von der Aussenwand der Grube vorhanden.

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[1]) Von den Tagraubvögeln ist der Sekretär (*Serpentarius*) in diesem Punkte von den anderen abweichend, indem der hintere Teil des Beckens und des Kreuzbeins nur wenig schräg gestellt ist, sogar weniger als bei den Westgeiern, was wohl zu der eigenartigen Lebensweise dieses Vogels in Verhältnis steht (Erdvogel, nicht Baumvogel).

Bei den Westgeiern ist das Foramen obturatorium in der Form einer deutlicher offenen Längsspalte vorhanden (die Spitze des Os ischii erreicht das Pubis und schliesst die Spalte caudal). Bei allen übrigen Raubvögeln legt sich das Pubis dem Os ischii dicht an, so dass das Foramen obturat. (mit Ausnahme selbstverständlich der Pars dissaepta) ganz geschlossen ist. Bei den Westgeiern ist das Pubis von gewöhnlicher Stärke, während es bei den übrigen meist mehr oder weniger geschwächt ist. Bei den Tagraubvögeln ist das Pubis eine Strecke weit caudad von der Pars dissaepta verdünnt (Tab. 6, Fig. 8) und bei den meisten Tagraubvögeln fehlt diese Strecke (Tab. 2, Fig. 3) beim erwachsenen Tier, so dass der Knochen in zwei Stücke geteilt ist, von denen der caudale frei unterhalb des Os ischii liegt. Vorhanden habe ich die Strecke — also das Pubis ganz — gefunden bei Haliaëtus albicilla, bei Falco gyrfalco, F. aesalon, F. tinnunculus (wahrscheinlich ist es so bei allen Falco-Arten, die dünne Partie ist ausserordentlich dünn und das Pubis ist oft an den Präparaten entzwei gegangen). Bei einem Nestjungen von Buteo vulgaris, der als Erwachsener ein geteiltes Pubis hat, habe ich ein kräftiges ungeteiltes Pubis gefunden; ob das auch bei anderen jungen Tagraubvögeln der Fall ist, ist zu untersuchen, ich habe nicht das Material dazu. Unterbrochen habe ich das Pubis gefunden bei: Aquila, Buteo, Pernis, Circus, Astur, Polyborus. Die Ostgeier verhalten sich ähnlich wie die Tagraubvögel. Unter ihnen habe ich das Pubis bei einem Neophron unterbrochen gefunden, während es bei dem einzigen Exemplar von Gyps barbatus ganz war und zwar recht stark. An dem übrigen vorliegenden Material von Ostgeiern war das Pubis überall beschädigt und es konnten die Verhältnisse bei denselben nicht sicher festgestellt werden. Offenbar wechseln die Verhältnisse ähnlich wie bei den Tagraubvögeln.

Es ist unverkennbar, dass die Beckenverhältnisse darauf hinweisen, dass die gänzliche Abtrennung der Eulen von den übrigen Raubvögeln, wie sie Fürbringer befürwortet hat, nicht das richtige trifft. Auch andere Data weisen nach derselben Richtung hin (vergl. meine Arbeit über den Hals der Vögel p. 192).

Wenn wir die Kreuzbein-Becken-Partie der vier grossen Raubvögel-Gruppen miteinander vergleichen, habe ich den Eindruck, dass die Westgeier das ursprünglichste Becken haben: 1) Der Knick des Beckens und des Kreuzbeins ist relativ schwach. 2) Das Foramen obturatorium ist offen. 3) Der Recessus iliacus ist eine laterad begrenzte Grube. Nr. 3 und einigermassen auch Nr. 1 haben die Eulen bewahrt, dagegen ist das Foram. obtur. geschlossen. Bei den Tagraubvögeln und den Ostgeiern ist das Becken stärker geknickt, das For. obtur. geschlossen und der Recessus iliacus laterad offen. Bei den Ostgeiern ist noch dazu die Recessus-Grube verflacht.

s. Oscines.

(Tab. 5, Fig. 3; Tab. 7, Fig. 5—6).

Ganz abweichend von den Verhältnissen bei den soeben behandelten Raubvögeln ist die caudale Partie (III—IV) des Sacrum nicht geknickt und von gewöhnlicher Länge, ebenso lang oder länger als der Abschnitt I. Die Querfortsätze der Wirbel *a* und *b* sind durchweg bescheiden entwickelt, am stärksten habe ich sie bei Corvus corax gefunden, meistens sind sie wenig von den der folgenden Wirbel abweichend und manchmal fast rückgebildet zu nennen. Der Querfortsatz des letzten Kreuzbeinwirbels hat gewöhnlich eine recht kleine Endfläche, bei den Corviden ist sie jedoch recht gross. Bei den kleinen Formen (Tab. 7, Fig. 5—6) sieht man an der Unterseite des Kreuzbeinstammes (der verschmolzenen Wirbelkörpernen), eine doppelte Reihe regelmässiger Vertiefungen, dünne Stellen der Röhrenwand andeutend.

Die Crista dorso-lateralis ist scharf, der Proc. iliolateralis deutlich, die Superficies dorsalis wohlentwickelt. Die Ossa ilium erreichen nicht den Dornfortsatz-Kamm. Die Crista iliaca post. ist deutlich, der Recessus iliacus aber nur angedeutet, am deutlichsten bei Corvus corax. Der Proc. terminalis isch. ist wohlentwickelt, beilförmig, caudal in ein spitzes Fortsätzchen ausgezogen. Das Foramen obtur. ist recht breit. Das caudale Ende des Ilium und des Os ischii ist nicht wie bei den Raubvögeln schräg gestellt oder sehr wenig.

t. Clamatores.

Cypselus (Tab. 3, Fig. 8). Die Querfortsätze von *a* sind so schwach entwickelt, dass sie kaum unterscheidbar sind; von Ventralast ist keine Spur. Noch schwächer sind die von *b*. Auch die Querfortsätze des letzten Wirbels von IV sind wenig ausgeprägt. Die Crista iliaca post. und auch die Crista intermedia sind deutlich; von einem Recessus iliacus kann man aber nicht reden. Die dorsale Kante des Ilium, die sonst den Dornfortsatz-Kamm erreicht, ist völlig verwischt. Die Crista dorso-lateralis ist undeutlich, die Superficies dorsalis gross. Das Os ischii heftet sich mit einer hinteren Spitze an das Pubis, das Foramen obturatorium ist breit.

Caprimulgus verhält sich in den meisten Punkten wie Cypselus, die Crista dorso-lateralis ist aber deutlich und ein Proc. iliolateralis vorhanden. Weiter legt sich das Pubis dicht dem Os ischii an, so dass das Foram. obtur. geschlossen ist. Die Ossa ilium sind weit von dem Kamm entfernt, die Kante des Ilium, die sonst die Verbindung herstellt, ist aber angedeutet.

Alcedo ispida. Der Ventralast von *a* ist lang und recht wohl entwickelt, heftet sich aber an das Ilium weit von dem Acetabulum. Der von *b* fehlt. Die Dorsalkanten der Ossa ilium erreichen nicht den Dornfortsatz-Kamm, sind aber recht deutlich. Das Foramen obturat. ist offen (wegen des defekten Zustandes des vorliegenden Materials kann weiteres nicht angegeben werden.)

Anthracoceros albirostris (Bucerotidae). Die Querfortsätze von *a* sind so schwach entwickelt, dass es unmöglich ist mit Sicherheit zu sagen, welcher Wirbel als *a* in Anspruch genommen werden soll. Die Crista dorso-lateralis ist undeutlich, die Superficies dorsalis nicht gross. Die Ossa ilium erreichen nicht den Dornfortsatz-Kamm, sind sogar weit von demselben entfernt. Die Crista iliaca post. ist eben nur angedeutet. (An dem einzigen vorliegenden Präparat waren die Ossa ischii und pubis beschädigt, so dass nichts von denselben gesagt werden kann.)

Columbidae (hauptsächlich Columba domestica). Das Sacrum ist ziemlich breit.

Ein recht starker Ventralast an *a*, der sich weit vom Acetabulum anheftet; an *b* fehlt er gewöhnlich. Das ganze Becken ist recht weit und offen. Die Crista dorso-lateralis ist deutlich, die Superficies dorsalis ziemlich gross. Die Dorsalkanten der Ossa ilium sind weit von dem Dornfortsatz-Kamm entfernt. Die Crista iliaca post. ist deutlich, von einem Recessus kann man aber nicht reden. Der Proc. terminalis isch. ist nicht sehr abgesetzt, verbindet sich eine ziemliche Strecke mit dem Pubis. Das Foram. obtur. ist sehr deutlich.

u. Scansores.

Picidae (Picus martius, viridis und major). (Tab. 6, Fig. 9—10) Die Ventraläste der Wirbel *a* und *b* sind sehr schwach, oftmals nicht vom Dorsalast gesondert, kaum stärker als die der folgenden Wirbel oder gar schwächer, wie ich bei einem Picus major fand. — Die oberen Kanten der Ossa ilium erreichen nicht den Dornfortsatz-Kamm, sind durch eine ziemlich breite Spalte von diesem getrennt. Die Crista dorso-lateralis ist deutlich, die Superficies dorsalis wohl entwickelt. Der Processus praeacetab. klein, aber vorhanden. Der Recessus iliacus ist kaum angedeutet, die Crista iliaca post. aber vorhanden. Der Proc. terminalis isch. ist beilförmig und mit dem Pubis verwachsen. Das Foram. obtur. ist breit.

Cuculus canorus. Die Querfortsätze von *a* und *b* sind kaum unterscheidbar, sind fast ganz den vorhergehenden und nachfolgenden gleich; Ventralast nicht gesondert. Bei dem einen untersuchten Exemplar ist ein dünner, aber sehr hervortretender Ventralast am ersten Wirbel des II. Abschn. vorhanden. — Die Wirbel des I. Abschnittes sind in der Dorsal-Ansicht ganz frei, indem die Dorsalkante des Ilium sich gar nicht erhebt (etwa wie bei Cypselus). Der Proc. terminalis isch. ist deutlich; er ist mit dem Pubis verbunden, nicht aber mit ihm verwachsen. Das übrige wie bei den Spechten beschrieben.

Rhamphastus (Tab. 5, Fig. 1—2). Bei dem einen untersuchten Exemplar (Tab. 5, Fig. 1) sind die Querfortsätze von *a* und *b* kaum von den folgenden und den vorangehenden unterscheidbar. Bei dem anderen Exemplar (Tab. 5, Fig. 2) ist dagegen an *a* ein deutlicher, ganz vom Dorsalast getrennter, aber dünner Ventralast vorhanden, an *b* ist auf der linken Seite ein ähnlicher vorhanden, der jedoch nur teilweise verknöchert ist. — Vom Becken ist hervorzuheben, dass die Dorsalkanten der Ossa ilium sich ähnlich wie bei den Spechten verhalten. Der Proc. inferior isch. ist mit dem Pubis verwachsen, das Band also verknöchert. Sowohl der Recessus wie die Crista iliaca post. sind verwischt. Der Proc. terminalis isch. wie bei Cuculus.

Psittacidae. Das Kreuzbein erinnert etwas an das der Raubvögel, indem das hintere Ende etwas mehr als gewöhnlich ventrad gebogen ist. Die Querfortsätze von *a* sind bedeutend stärker als die vom II. Abschnitt, wenn auch nur von bescheidener Entwicklung und wenig stärker als die von *b* und die folgenden. — Die Dorsalkanten der Ossa ilium sind mit dem Dornfortsatz-Kamm in typischer Weise verwachsen. Der Recessus iliacus ist nur angedeutet, die Crista iliaca post. kann stärker oder sehr schwach sein.

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Berichtigung zu der Arbeit des Verf. ü. d. Vogelhals.

p. 210 (110) Zeile 16. Statt »Spheniscus sp. (andere Art)« soll stehen: *Pygoscelis papua.* Und statt *3** soll stehen *4**. Der Satz in der Rubrik rechts »Es ist nicht sicher etc.« geht aus. (Es hat sich beim Hervorfinden des übrigen Skeletts des Vogels ergeben, dass wirklich 4 Wirbel in diesem Abschnitt vorhanden sind).

TABELLEN

über die Zusammensetzung des Kreuzbeins bei einer Anzahl Vögel. I, II etc. die verschiedenen Abschnitte. Ia die rippentragenden Wirbel des I. Abschnittes; Ib die rippenlosen desselben Abschnittes. *S* die Summe sämtlicher Kreuzbein-Wirbel.

	Ia	Ib	II	III	IV	S	
Tinami.							
Crypturus obsoletus, *A*	1	3	5	2[4]	4	15	[4] Ventralast an *a*, fehlt an *b*, dessen Dorsalast nicht stärker ist als der der folgenden Wirbel.
— — *B*	1	3	5[3]	2[4]	4	15	[3] Der Ventralast von Nr. 5 ist an der linken Seite entwickelt wie an einem *a*. [4] Ventralast von *a* nur an der rechten Seite vorhanden, an der linken Seite fehlt er ebenso wie beiderseits an *b*.
— — *C*	1	3	5[3]	2[4]	5	16	[3] Auf der rechten Seite trägt Nr. 1 einen recht starken Ventralast. [4] Wie bei *A*.
— — *D*	1	3	4	2[4]	5	15	[4] Wie bei *A*.
Crypturus tataupa, Junges ..	0	4	4	2	4	14	
Notoprocta ornata, *A*	1[1]	4[2]	5[3]	2[4]	5	17	[1] Noch nicht mit dem folgenden Wirbel verwachsen. [2] Ventralast an *α* schwächer als an *β*. [3] Querfortsatz nur an Nr. 4. [4] Vom Ventralast des *b* ist nur der Basalteil vorhanden.
— — *B*	1[1]	4[2]	5[3]	2[4]	5	17	[1] Wie *A*. [2] Wie *A*. [3] Wie *A*. [4] Wohlentwickelter Ventralast an *b*.
— — *C*	1[1]	4[2]	5[3]	2[4]	5	17	[1] Festgewachsen. [2] Wie *A*. [3] Wie *A*. [4] Wohlentw. Ventralast an *b*, links stärker als rechts und mit dem von *a* distal verwachsen (was rechts nicht der Fall).
Rhynchotus rufescens, *A* ...	1	4[2]	5[3]	2[4]	4	16	[2] Wie bei Notoprocta. [3] Nur die zwei hinteren Wirbel mit deutlichem Querfortsatz. [4] *b* ohne Spur von Ventralast.
— — *B* ...	1	4	4	2[4]	5	16	[4] Wie bei *A*.
— — *C* ...	1	4	4	2[4]	5	16	[4] Wie bei *A*.
Ratitae.							
Struthio camelus, *A*	2	6	2[3]	2	8	20	[3] Ventralast an Nr. 1.
— — *B*	2	6	2[3]	2	9	21	[3] Unvollständiger Ventralast an Nr. 1.
— — *C*	2	6	2[3]	2	7[5]	19	[3] Starker Ventralast an Nr. 1. [5] Der Wirbel c mit einem Querfortsatz mit gesondertem Ventralast, der mit dem von *b* verwachsen ist.
— — *D*	2	6	2[3]	2	8	20	[3] Kurzer, kräftiger unvollständiger Ventralast an Nr. 1.

	Ia	Ib	II	III	IV	S	
Ratitae (Forts.)							
Rhea, *A*	1	4	5[3]	2[4]	5?	17?	[3] Plattenförmiger, dünner, recht grosser Ventralast an Nr. 5. [4] Querfortsätze nicht viel abweichend von denen der folgenden Wirbel.
— *B*	2[1]	4	4[3]	2	5	17	[1] Rippe des letzten Wirbels rudimentär. [3] Nr. 4 wie Nr. 5 von *A*.
— *C*	1	4	5[3]	2	?		[3] Wie bei *A*.
— *D*	1	4	5[3]	2	5	17	[3] Kein Ventralast an Nr. 5.
— *E*	1?	4	5[3]	2[4]	?		[3] Wie bei *D*. [4] Dünne Ventraläste.
— *F*	1[1]	4	?	2	?		[1] Vor diesem Wirbel ein freier W., dessen Querfortsätze unter dem Ilium liegen.
— *G*	1[1]	3	6[3]	2	?		[1] Wie F. [3] Nr. 6 mit einem dünnen Ventralast.
Casuarius, 14/3 02, *A*	1	6	3[3]	2	9	21	[3] Kurzer starker Ventralast an Nr. 1.
— 1792, *B*	1	7	3	2	10	23	
Dromaeus, *A*	1	6	3[3]	2	10	22	[3] Keine Ventraläste an den Wirbeln dieses Abschnittes. Ob 2 oder 3 Wirbel in demselben vorhanden, ist unsicher.
— , *B*	1	6	3[3]	2	9[5]	21	[3] Recht starker Ventralast an Nr. 1. [5] Ventraläste an *c* u. *d*, ähnlich aber stärker als die an *a* u. *b*.
Apteryx (montiertes Skelett)	3[1]	4	4[3]?	2[4]	4[5]	17	[1] Die beiden ersten Wirbel sind kaum mit dem Kreuzbein verwachsen, liegen aber ganz unter dem Ilium; grosse Rippen an allen drei. [3] Die Zahl lässt sich nicht sicher ermitteln; alle sind ohne Ventraläste, die Partie hat ganz das Aussehen des II. Abschnittes bei typischen Vögeln. [4] Beide mit starken Ventralästen. [5] Fast ganz ohne Querfortsätze; die Wirbelkörper zusammengedrückt, liegen grösstenteils ventral von den Rändern des Ilium.
Rasores.							
Mitua mitu	1	3	4	2[4]	6	16	[4] Beide mit starkem Ventralast.
Crax alector	1[1]	3	5	2	5	16	[1] Ausserdem ein freier Wirbel, der unterhalb des Ilium liegt.
Tetrao urogallus, *A*	1	3	5	2[4]	5[5]	16	[4] Wirbel *b* ganz wie *c*. [5] Der letzte Wirbel erreicht nicht das Ilium.
— — *B*	1	3	5	2[4]	4	15	[4] Wie *A*.
Lagopus, *A*	1	3	5	2	4	15	
— *B*	1	3	4	2	5	15	
— *C*	1	3[2]	4	2	5	15	[2] An Nr. 3 fehlt der Ventralast rechts und erreicht links nicht das Ilium.
— *D*	1	3	4	2	5	15	
Chrysolophus pictus, *A*	1	4	5	2	3	15	
— — *B*	1	4[2]	5[3]	2	3	15	[2] Rudiment von einer festgewachsenen Rippe an Nr. 1. [3] Ventralast an Nr. 1.

	Ia	Ib	II	III	IV	S	
Rasores (Forts.)							
Phasianus colchicus, Pull., *A*	1	4	5	2	4	16	
— — *B*	1	4	5	2	4	16	
— — *C*	2[1]	3	5	2[4]	4	16	[1] Rippe von Nr. 2 sehr schwach und nur mit dem Querfortsatz verbunden (nicht mit dem W.körper). [4] Ventralast von *α* fehlt.
— Reevesi	1	3	6	2	5	17	
Gallus domesticus, *A*	1	3	5	2	4	15	
— — *B*	1	3	5	2	4	15	
— — *C*	1	3	5[3]	2	?		[3] Dünner Ventralast an Nr. 5.
— — *D*	1	4[2]	4	2	5	16	[2] Der Querfortsatz von *α* schwächer als der von *β*.
— — *E*	1	3	5	2[4]	5	16	[4] Der Ventralast von *α* rechts sehr schwach, links stark.
— — *F*	1	3	4	2[4]	5	15	[4] Ventralast fehlt an *α* links.
— — *G*	0	4	4	2	4[5]	14	[5] Möglicherweise noch 1 Wirbel (es ist von einem jungen Tier).
— — *H*	1	4[2]	4	2	4[5]	15	[2] Ventralast von *α* schwach, so dass der betreffende W. möglicherweise zu II gehört. [5] Wie *G*.
— — *I*	1	3	5	2	4	15	
— — *K*	1	3	5	2	4	15	
Pavo cristatus, *A*	2[1]	3	4	2	4	15	[1] Rechte Rippe am 2. Wirb. ist in zwei gebrochen, der basale Teil festgewachsen, $2^1/_2$ cm lang.
— — jung, *B*	1[1]	3	4	2	4	14	[1] Ganz kurze, freie Rippen. Vor diesen ein freier Brustwirbel, der unter dem Ilium liegt.
— — *C*	2	3	4	2	4	15	
— — *D*	2	3	4	2	4	15	
— — *E*	1	3	4	2	4	14	
— — jung, *F*	1	3	5[3]	2	3	14	[3] Nr. 1 mit einer Andeutung eines Ventralastes.
Meleagris gallopavo, *A*	1	4[2]	5[3]	2	6	18	[2] Spur einer festgewachsenen Rippe links an dem vordersten. [3] Nr. 5 mit einem dünnen Ventralast.
— — *B*	1	3	5[3]	2	6	17	[3] Nr. 1 mit ziemlich starkem Ventralast.
Francolinus	1	3	5[3]	2	5	16	[3] Recht wohlentwickelter Ventralast an Nr. 1.
Perdix cinerea	1	3	5	2	4	15	
Numida meleagris *A*	1	4	4	2	6	17	
— — *B*	1	4	4	2	5	16	
Natatores.							
Longipennes.							
Larus marinus, *A*	2	3	4	2	3	14	
— — *B*	2	3	4	2	3	14	
— — *C*	2	3	4[3]	2	3	14	[3] Schwacher Ventralast an Nr. 1.
— — *D*	2	3	4	2	3	14	
— argentatus	2	3	4	2	3	14	
— leucopterus, *A*	2	3	4	2	3	14	
— — *B*	2	3	4	2	3	14	

	Ia	Ib	II	III	IV	S	
Natatores (Forts.)							
Larus tridactylus	2	3	4	2	3	14	
— canus, *A*	2	3	4	2	3	14	
— — *B*	1	4[2]	3	2[4]	3	13	[2] Querfortsatz von *a* teilweise nicht verknöchert, heftet sich aber wie gewöhnlich an die Crista obliqua. [4] Wohlentwickelter Ventralast an *b* im Gegensatz zu den übrigen untersuchten Larus-Exemplaren.
— ridibundus, *A*	2[1]	3	4	2	3	14	[1] Nr. 1 liegt ganz *vor* dem Ilium.
— — *B*	2	3	4	2	2	13	
Sterna cantiaca	2[1]	3	4	2	3	14	[1] Nr. 1 wie bei Larus ridib. *A*.
— macrura	2	2	4[3]	2	3	13	[3] Andeutung eines Ventralastes an Nr. 1.
— hirundo *A*	2[1]	3	3	2[4]	3	13	[1] Nr. 1 wie bei L. rid. *A*. [4] An b kein Ventralast.
— — *B*	2[1]	2	4[3]	2[4]	3	13	[1] Nr. 1 wie bei *A*. [4] Ventralast am *a* nur links, am *b* nur rechts, links nur ein Rudiment. [3] Nr. 1 rechts mit Ventralast.
— — *C*	1	3	4[3]	2	3	13	[3] Am Nr. 1 jederseits ein wohlentwickelter Ventralast, jedoch ein wenig schwächer als der am *a*.
— — *D*	1	3	4	2	3	13	
— minuta	1	3	2	2	3	11	
Lestris pomar.	2	3	4	2	3	14	
Steganopodes.							
Sula, *A*	3[1]	3	3[3]	2	4	15	[1] Nr. 1 liegt ganz *vor* dem Ilium. [3] Andeutung eines Ventralastes an Nr. 3 und ganz wenig an Nr. 2.
— *B*	3[1]	3	3[3]	2	4	15	[1] Wie A. [3] An Nr. 3 ein Ventralast der vollkommen so stark ist als der am *a* und distal mit ihm verwachsen ist.
— *C*	3	3	2	2[4]	5	15	[4] Sowohl *a* wie *b* mit Ventralast, während bei den drei anderen Sulen an *b* keiner vorhanden ist.
— *D*	3	3	3	2	5	16	
Pelecanus, *A*	4[1]	4	3	2	5	18	[1] Die drei ersten Wirbel vor dem Ilium, der dritte jedoch nur teilweise.
— *B*	4[1]	3	4[3]	2	4	17	[1] Die drei ersten Wirbel ganz vor dem Ilium. [3] Nr. 1 mit einem dünnen Ventralast.
— *C*	4[1]	3	3[3]	2	5	17	[1] Wie *A*. [3] Nr. 1 mit einem dünnen nur teilweise verknöcherten Ventralast.
Graculus carbo, *A*	2	4	2	2[4]	7	17	[4] Kein Ventralast an *b*.
— — *B*	3[1]	3	2[3]	2[4]	7	17	[1] Schwache, festgewachsene Rippe an Nr. 3. [3] Starker Ventralast an Nr. 1. [4] Dünner Ventralast links an *b*.
— — *C*	3[1]	3	2[3]	2[4]	7	17	[1] Nr. 1 liegt ganz vor dem Ilium. [3] Starker Ventralast an Nr. 1. [4] Starker Ventralast an *b*.
— — *D*	2	4	2	2[4]	7	17	[4] Kein Ventralast an *b*.

	Ia	Ib	II	III	IV	S	
Natatores (Forts.)							
Plotus anhinga	2[1]	4	2[3]	2[4]	4	14	[1] Nr. 1 liegt vor dem Ilium. [3] Nr. 1 mit starkem Ventralast. [4] Dünner Ventralast an *b*.
Colymbidae.							
Colymbus arcticus, *A*	2	3	4	2	6[5]	17	[5] Nr. 6 ist frei, aber unbeweglich.
— — *B*	2	3	4	2	6[5]	17	[5] Wie bei *A*.
Podicipes rubricollis	2	4	4	2	5[5]	17	[5] Nr. 5 wie Nr. 6 bei Colymbus.
— griseigena	2	3	4	2	6[5]	17	[5] Wie bei Colymbus.
Alcidae.							
Alca torda, *A*	1	3	4[3]	2	2[5]	12	[3] Ziemlich starker Ventralast an Nr. 1. [5] Nach dem letzten Kreuzbeinwirbel folgt ein freier Wirbel, dessen starke Querfortsätze sich ebenfalls mit dem Ilium verbinden.
— — *B*	1	3	5[3]	2	2	13	[3] Wie bei *A*.
— — *C*	1	3	4[3]	2	2	12	[3] Ziemlich schwacher Ventralast an Nr. 1.
— — *D*	1	3	4[3]	2	3	13	[3] Sehr starker Ventralast an Nr. 1.
— — *E*	1	3	4[3]	2	2	12	[3] Starker Ventralast an Nr. 1.
— — *F*	1	3	4[3]	2	3	13	[3] Schwacher Ventralast an Nr. 1.
Mormon fratercula	1	4	3	2	4	14	
Uria grylle, *A*	1	4	3	2	4	14	
— — *B*	1	3	4[3]	2	3	13	[3] Schwacher Ventralast an Nr. 1.
— troile	1	4	4[3]	2	3	14	[3] Schwacher Ventralast an Nr. 1.
— Brünnichii, *A*	1	3	4[3]	2	3	13	[3] Schwacher Ventralast an Nr. 1.
— — *B*		3	4[3]	2			[3] Wie *A*.
— sp.	1	4	4	2	2	13	
Mergulus alle, *A*	1	3	4[3]	2	2	12	[3] Schwacher Ventralast an Nr. 1, starker an Nr. 4.
— — *B*	1	3	3[3]	2	2	11	[3] Schwacher Ventralast an Nr. 1.
Impennes (Spheniscidae).							
Spheniscus demersus, *A*	1	4	3[3]	2	3	13	[3] Nr. 1 mit starkem Ventralast.
— — *B*	1	3	3[3]	2	3	12	[3] Nr. 1 mit Ventralast.
— — *C*	1	4	3[3]	2	3	12	[3] Nr. 1 mit starkem Ventralast, über welchen der Nerv *1i* quer verläuft, wodurch entschieden wird, dass der Wirbel nicht *α* ist.
— — *D*	1	4	3[3]	2	4	14	[3] Wie *C*.
— — *E*	1	4	3[3]	2	3	13	[3] An Nr. 1 ein schwacher Ventralast. An Nr. 3 recht starke Querfortsätze, die mit denen von *a* verwachsen sind.
Pygoscelis papua	2[1]	4	4	2[4]	3	15	[1] Nr. 1 ist nur in begrenzter Ausdehnung mit dem zweiten verwachsen. [4] Es ist sehr schwierig zu entscheiden, wo der II. Abschnitt aufhört und der III. anfängt. Es ist zweifelhaft, ob der hier als *a* gerechnete Wirbel nicht in der Tat ein 5. vom II. Abschnitt ist. Die Querfortsätze sind alle fast gleich in dem II. und III. Abschnitt.

	Ia	Ib	II	III	IV	S	
Natatores (Forts.)							
Lamellirostres.							
Anas boschas	3	3	3	2	6	17	
Anas domestica, *A*	2	3	4[3]	2	6	17	[3] Recht starker Ventralast an Nr. 1, rudimentärer an Nr. 4.
— — *B*	3	3	5[3]	2	5	18	[3] Ventralast an Nr. 1 und 5.
— — *C*	3	2	4[3]	2	5	16	[3] Ventralast an Nr. 1 und 4.
— — *D*	3	3	4[3]	2	?		[3] Ventralast an Nr. 1.
— — *E*	3	3	4[3]	2	5	17	[3] Wie *D*.
— crecca	2	3	4[3]	2	4[5]	15	[3] Dünne, teilweise unterbrochene Ventraläste an Nr. 1 und 4. [5] Ausserdem ein freier Wirbel, dessen Queräste sich an das Ilium heften.
— acuta	4[1]	2	3[3]	2	6	17	[1] Der vorderste W. liegt teilweise vor dem Ilium. [3] Rudiment eines Ventralastes an Nr. 1.
Aix galericulata	3[1]	3	3	2	5	16	[1] An Nr. 3 nur auf der einen Seite eine Rippe (festgewachsen).
— sponsa	2	4	3	2[4]	6	17	[4] Der Ventralast von *a* rechts zu einem Faden reduziert, links stark, an *b* sind die Ventraläste stärker als der linke von *a*.
Tadorna casarca	3	3	4	2	5	17	
Fuligula marila	3	3	4	2	6	18	
Somateria molliss., *A*	3	2	5[3]	2	5	17	[3] Grosser Ventralast an Nr. 1.
— — *B*	2	2	5[3]	2	5	16	[3] Wie *A*.
Mergus merganser	3	3	4	2	6	18	
Anser cinereus	3	3	4	2	6	18	
— domest., *A*	3	3	4	2	6	18	
— — *B*	3	3	4	2	7[5]	19	[5] Der letzte frei, nicht mit dem vorhergehenden verwachsen, verbindet sich aber mit dem Ilium.
— — *C*	3	4	3	2[4]	6	18	[4] Ventralast von *a* schwächer als der von *b*.
— — *D*	3	4	4	2	7	20	
— — *E*	3	4	3	2	7[5]	19	[5] Wie *B*.
— — *F*	3	3	3	2	7[5]	18	[5] Wie *B*.
— — *G*	3	3	4	2	7[5]	19	[5] Wie *B*.
— — *H*	3	3	3[3]	2	7	18	[3] Nr. 1 links mit schwachem Ventralast.
Cygnus atratus	3	4	4[3]	2	9[5]	22	[3] Ventralast an Nr. 1 und rechts an Nr. 4. [5] Nr. 9 frei, heftet sich jedoch an das Ilium.
— musicus, ad., *A*	5	3	4	2[4]	7	21	[4] An *a* fehlt der Ventralast links, rechts ist er dünn.
— — pull., *B*	4	4	3	2	8	21	
— olor	4	3	3	2	9	21	
Cygnus sp. (entw. musicus od. olor)	5	3	4[3]	2[4]	8	22	[3] Nr. 4 mit kräftigem Ventralast, der sich distal mit dem von *a* verbindet. [4] *b* mit recht starkem Ventralast.
Chauna chavaria	2[1]	4	4[3]	2	3	15	[1] Ausserdem ein freier Wirbel unterhalb des Ilium. [3] Starker Ventralast an Nr. 1, rud. an Nr. 4 links.

	Ia	Ib	II	III	IV	S	
Natatores (Forts.)							
Phoenicopterus, *A*	1	4	3	2	4	14	
— *B*	2	3	4	2	5	16	
Grallatores.							
Herodii.							
Ardea cinerea, *A*	2[1]	4	3	2	4[5]	15	[1] Rippe von Nr. 2 rudim., festgewachsen. [5] Querfortsatz von Nr. 4 berührt nur wenig das Ilium.
— — *B*	1	4	2	2	5[5]	14	[5] Nr. 5 verhält sich wie Nr. 4 von *A*.
— — *C*	2	3	3[3]	2	5[5]	15	[3] Recht starker Ventralast an Nr. 1. [5] Nr. 5 mehr mit dem Ilium verbunden als bei *B*.
— — *D*	1	4	3	2	4	14	
— — *E*	1	4	3	2	4	14	
Botaurus stellaris	1	4	4[3]	2	3	14	[3] Ventralast an Nr. 1.
Pelargi.							
Ciconia alba, *A*	1	4	4[3]	2	4	15	[3] Dünner Ventralast an Nr. 4.
— — *B*	1	4	4[3]	2[4]	4	15	[3] Dünner Ventralast an Nr. 1. [4] Ventralast an *a* rechts ganz dünn, nur teilweise verknöchert.
— — *C*	1	4	4[3]	2	4	15	[3] Dünner Ventralast an Nr. 4.
— — *D*	1	4	4	2	5[5]	16	[5] Nr. 5 liegt ganz ausserhalb des Beckens.
— — *E*	1	4	4[3]	2	4[5]	15	[3] Wie C. [5] Nr. 4 fast wie Nr. 5 in D.
— — *F*	?	4	4[3]	2	4		[3] Wie C.
— — *G*	?	?	4[3]	2	4[5]		[3] *Starker* Ventralast an dem letzten Wirbel. [5] Wie E.
— nigra	1	4	4	2	4	15	
Leptoptilus	1	4	4[3]	2	3	14	[3] Dünner Ventralast an Nr. 4.
Dissoura episcopus	1	5	3	2	4	15	
Platalea	1	4	3	2	5	15	
Charadriidae.							
Charadrius hiaticula	1	3	3	2	3	12	
— squatarola, *A*	2	3	4	2	2	13	
— — *B*	1	3	4[3]	2	3	13	[3] Rud. Ventralast an Nr. 1.
Strepsilas interpres	1	3	4	2	2	12	
Haematopus ostralegus, *A*	2	3	4	2[4]	4	15	[4] Ventralast von *a* rechts stark, links schwach, grösstenteils unverknöchert. Ventralast von *b* rechts fast so stark wie bei *a* rechts, links stärker als bei diesem.
— — *B*	2	3	4	2[4]	4	15	[4] Ventralast fehlt an *b*.
Rallidae.							
Porphyrio sp., *A*	2	4	4	2	3	15	
— coeruleus, *B*	2	4	4	2[4]	4	16	[4] Ventralast an *b* stark, an *a* schwächer, rechts unvollständig.
— sp., *C*	2	4	4[3]	2	3	15	[3] An Nr. 4 ein recht wohlentw. Ventralast.
Fulica atra, *A*	1	4	4[3]	2	5	16	[3] Recht starker Ventralast an Nr. 1.

	Ia	Ib	II	III	IV	S	
Natatores (Forts.)							
Fulica atra *B*	1	4	4^{3}	2	5	16	[3] Wie A.
— — *C*	1	4	4^{3}	2	5	16	[3] Schwacher Ventralast an Nr. 1.
— — *D*	1	4	4^{3}	2	4	15	[3] Sehr schwacher, nur teilweise knöcherner Ventralast an Nr. 1.
Gallinula chloropus *A*	1	4	4^{3}	2	3	14	[3] Recht starker Ventralast an Nr. 1.
— — *B*	1	4	4^{3}	2	4	15	[3] Schwacher Ventralast an Nr. 1.
— — *C*	1	4	4	2	4	15	
— — *D*	1	4	4	2	4	15	
Rallus aquaticus	1	5	4	2	3	15	
Gruidae.							
Grus cinerea	3	4	3	2	5	17	
— sp.	2	4	3	2	5	16	
— (Anthropoides) paradisea	3	4	3	2	5	17	
— japonensis	3	4	3	2	5	17	
Dicholophus (Seriema)	2	4	2	2	6^{5}	16	[5] Der Querfortsatz des hintersten berührt nicht das Ilium.
Debilirostres.							
Scolopax major *A*	1	3	5	2^{4}	3	14	[4] Ventralast von *b* wohlentwickelt.
— — *B*	1	3	4^{3}	2^{4}	3	13	[3] Andeutung eines Ventralastes an Nr. 1 rechts. [4] Ventralast an *b* fehlt.
— rusticola 2 Ex.	2	3	4	2^{4}	3	14	[4] Ventralast an *b* fehlt.
Limosa lapponica	1	3	4^{3}	2^{4}	4	14	[3] Kleiner Ventralast an Nr. 1. [4] Ventralast an *b* fehlt.
Tringa alpina 2 Ex. *A*	1	3	4	2^{4}	3	13	[4] Ventralast an *b* fehlt.
— — *B*	1	3	4	2^{4}	3	13	[4] Ventralast fehlt bei *a* links, bei *b* rechts.
Totanus ochropus	1	3	4	2^{4}	3	13	[4] Ventralast fehlt rechts am *b*, ist links vorhanden.
Recurvirostra	1	3	4^{3}	2^{4}	3	13	[3] Kleiner Ventralast an Nr. 1. [4] Kein Ventralast an *b*.
Numenius arquatus	1	4	4	2	3	14	
Rapaces.							
Hemeroharpages.							
Haliaëtus albicilla *A*	2	3	5^{3}	2	2	14	[3] Sehr starker Ventralast an Nr. 1.
— — *B*	2	3	5^{3}	2	3	15	[3] Starker Ventralast an Nr. 1 (dass es dieser Wirbel ist, geht aus einem Nervenpräparat hervor).
— — *C*	2	3	5^{3}	2	2	14	[3] Starker Ventralast an Nr. 1, dünner an Nr. 2.
— — *D*	2	4	4^{3}	2	2	14	[3] Schwacher Ventralast an Nr. 1.
Aquila chrysaëtus *A*	2	3	5^{3}	2	2	14	[3] Nr. 1 mit einem Ventralast, der links dünn ist, rechts aber fast ebenso stark wie der von *a*.
— — *B*	3	3	4^{3}	2	2	14	[3] Ziemlich starker Ventralast an Nr. 1.
Falco gyrfalco *A*	1	4	3^{3}	2	2	12	[3] Ventralast an Nr. 1 auf der rechten Seite.
— — *B*	1	4	3^{3}	2	3^{5}	13	[3] Ventralast an Nr. 1 beiderseits. [5] Nr. 3 heftet sich nicht an das Ilium.

	Ia	Ib	II	III	IV	S	
Rapaces (Forts.)							
Falco gyrfalco, *C*	1	4	3[3]	2	2	12	[3] Wie *A*.
— peregrinus, *A*	1	4	3[3]	2	2	12	[3] Ventralast an Nr. 1.
— — *B*	1	4	3[3]	2	2	12	[3] Wie *A*.
— aesalon, *A*	1	3	4	2	2	12	
— — *B*	1	3	4	2	2	12	
— — *C*	1	3	4	2	2	12	
— tinnunculus, *A*	1	3	3[3]	2	3	12	[3] Ventralast an Nr. 1.
— — *B*	1	3	3[3]	2	2	11	[3] Starker Ventralast an Nr. 1.
— — *C*	1	3	4[3]	2	2	12	[3] Recht starker Ventralast an Nr. 1.
Astur palumbarius, *A*	2	3	5[3]	2	2	14	[3] Nr. 5 mit starkem Ventralast, der sich an den von *a* heftet, und an Nr. 1 ebenfalls ein recht starker Ventralast.
— — *B*	2	3	5[3]	2	2	14	[3] Unterbrochener Ventralast an Nr. 1.
— — *C*	2	3	5[3]	2	2	14	[3] Ventralast an Nr. 1.
— nisus, *A*	2	3	5[3]	2	2	14	[3] Ventralast an Nr. 1.
— — *B*	2	3	5[3]	2	2	14	[3] Ventralast an Nr. 5 (recht stark).
— — *C*	2	3	5[3]	2	2	14	[3] Wie *B*.
— — *D*	2	3	5[3]	2	2	14	[3] Ventralast an Nr. 1.
— — *E*	2	3	5	2	2	14	
Pernis apivorus, *A*	2	3	4	2	2	13	
— — *B*	2	3	4	2	3	14	
Buteo vulgaris, *A*	2	4	4	2	2	14	
— — *B*	2	4	3	2	3	14	
— — pull., *C*	2	4	3	2	3	14	
Circus aeruginosus	2	4	4	2	2	14	
— cyaneus, *A*	2	4	4	2	2	14	
— — *B*	2	4	4	2	2	14	
— — *C*	2	4	4	2	2	14	
Gypogeranus serpentarius	2[1]	4	3	2	4	15	[1] Nr. 2 mit festgewachsener Rippe.
Saproharpages (Ostgeier).							
Gyps fulvus, *A*	3[1]	3	4	2	3	15	[1] Der dritte Wirbel mit einer festgewachsenen rudim. Rippe.
— — *B*	3[1]	3	4[3]	2	3	15	[1] Wie A. [3] Nr. 1 mit starkem Ventralast.
— — *C*	3[1]	3	4[3]	2[4]	3	15	[1] Wie A. [3] Nr. 1 mit Ventralast, der aber rechts nur teilweise verknöchert ist. [4] Ventralast von *a* schwächer als der von *b*, besonders rechts.
— — *D*	3[1]	3	4[3]	2	3	15	[1] Wie A. [3] Nr. 4 rechts mit starkem Ventralast, der sich distal mit dem von *a* verbindet.
— barb.	3[1]	2	4[3]	2	3	14	[1] Wie Gyps fulvus. [3] Nr. 1 mit nur teilweise verknöchertem Ventralast.
Neophron pil.	3[1]	3	4[3]	2	3	15	[1] Wie Gyps. [3] Nr. 4 links mit einem nur proximal u. distal verknöcherten Ventralast.
— percnopterus	3[1]	2	4[3]	2	3	14	[1] Sowohl Nr. 2 wie 3 mit ähnlicher festgewachsener Rippe wie Nr. 3 bei Gyps.

	Ia	Ib	II	III	IV	S	
Rapaces (Forts.)							
Necroharpages (Westgeier).							
Sarcorhamphus gryphus, *A*	3[1]	3	3	2	4	15	[1] Nr. 1 mit dünnem Ventralast.
— — *B*	3	3	4[3]	2	3	15	[3] Rippe von Nr. 3 festgewachsen.
Cathartes atratus	3	2	4[3]	2	3	14	[3] Starker Ventralast an Nr. 1.
Nyctharpages (Eulen).							
Bubo maximus, *A*	1	4	4[3]	2	3	14	[3] Nr. 1 mit recht starkem Ventralast.
— — *B*	1	4	3	2	4	14	
— — *C*	1	4	3	2[4]	3	13	[4] Ventralast von *a* verdünnt, besonders links
Nyctea nivea, *A*	1	4	3	2	3	13	
— — *B*	1	4	3[3]	2	3	13	[3] Nr. 3 mit fadenförmigem Ventralast.
Surnia ulula	1	4	3[3]	2	3	13	[3] Nr. 3 mit dünnem Ventralast.
Athene noctua	1	4	3	2	3	13	
Otus vulgaris, *A*	1	4	3	2	3	13	
— — *B*	1	4	3	2	3	13	
— — *C*	1	4	3	2	3	13	
— brachyotus, *A*	1	4	3	2	3	13	
— — *B*	1	4	3·	2	3	13	
— — *C*	1	4	3	2	3	13	
Syrnium aluco, *A*	2[1]	3	3[3]	2	3	13	[1] Rippe von Nr. 2 rechts festgewachsen. [3] Nr. 1 mit starkem Ventralast.
— — *B*	1	4	3	2	3	13	
— — *C*	1	4	3[3]	2	3	13	[3] Nr. 1 mit schwachem Ventralast.
— — *D*	1	4	3	2	2	12	
Strix flammea	1	4	3[3]	2	4[5]	14	[3] Nr. 1 mit haarfeinem Ventralast, Nr. 3 mit starkem do., der sich mit dem Ventralast von *a* verbindet. [5] Nr. 4 erreicht nicht das Ilium.
Oscines.							
Sylvia schoenob.	1	3	2	2	3	11	
Motacilla alba	1	2	3	2	3	11	
Cinclus aquaticus	2[1]	3	2	2	3	12	[1] Nr. 1 liegt fast ganz vor dem Ilium, Nr. 2 hat nur links eine Rippe.
Troglodytes parv., *A*	1	3	2	2	3	11	
— — *B*	1	3	2	2	3	11	
Regulus crist., 2 Ex., *A*	1	2	3	2	2	10	
— — *B*	1	2	3	2	2	10	
— — *C*	1	2	3[3]	2	2	10	[3] Nr. 3 mit starkem Ventralast.
Parus sp.	1	3	2	2	3	11	
— major	1	3	3	2	2	11	
— caudatus	1	3	2	2	3	11	
Sitta europaea	1	3	2	2	3	11	
Certhia famil.	1	3	2	2	2	10	
Passer domest.	1[1]	2	3	2	2	10	[1] Rippe festgewachsen, scheint rechts ganz zu fehlen.
Fringilla canaria	0	3	2	2	3	10	

	Ia	Ib	II	III	IV	S	
Rapaces (Forts.)							
Plectrophanes nivalis	1	2	3	2	3	11	
Emberiza miliaria	1	2	3	2	3	11	
Sturnus vulgaris, *A*	1	3	3	2	3	12	
— — *B*	1	3	3[3]	2	3	12	[3] Starker Ventralast an Nr. 1 links, schwache Andeutung rechts.
— — *C*	1	3	3	2	3	12	
Corvus corax, *A*	1	3	3[3]	2	2	11	[3] Dünner Ventralast an Nr. 1.
— — *B*	1	3	2	2	3	11	
— — *C*	1	3	2	2	3	11	
— cornix, *A*	1	3	2	2	2	10	
— — *B*	1	3	3[3]	2	2	11	[3] Rud. Ventralast an Nr. 3 links.
— — *C*	1	3	2	2	3	11	
— — *D*	1	3	3	2	2	11	
— — *E*	1	3	2	2	3	11	
— — *F*	1	3	2	2	3	11	
— — *G*	1	3	3	2	2	11	
— frugilegus, *A*	1	3	3[3]	2	2	11	[3] Ventralast-Rud. an Nr. 3 rechts.
— — *B*	1	3	2[3]	2	4[5]	12	[3] Ventralast an Nr. 1. [5] Die Querfortsätze von Nr. 4 erreichen nicht das Ilium.
— — *C*	1	3	2	2	3	11	
— — *D*	1	3	3[3]	2	2	11	[3] Schwacher Ventralast an Nr. 1.
— — *E*	1	3	2[3]	2	3	11	[3] Haarfeiner Ventralast an Nr. 1.
— — *F*	1	3	3[3]	2	2	11	[3] Unvollständ. Ventralast an Nr. 1.
— — *G*	1	3	3	2	2	11	
Pica caudata	1	3	2[3]	2	3	11	[3] Ventralast an Nr. 1.
Garrulus gland., *A*	1	3	2	2	3	11	
— — *B*	1	3	2[3]	2	3	11	[3] Dünner Ventralast an Nr. 2.
Nucifraga caryocat.	1	3	3	2	2	11	
Hirundo riparia	1	2	3	2	3	11	
Clamatores.							
Cypselus apus, *A*	1	2	3	2	2	10	
— — *B*	3[1]	1	2	2	3	11	[1] Der vorderste W. liegt ganz vor dem Vorderende des Ilium.
Caprimulgus europaeus	2	1	3[3]	2	4	12	[3] Nr. 1 mit einem dünnen Ventralast.
Alcedo ispida, *A*	1	2	3[3]	2	4	12	[3] Fadenförm. Ventralast an Nr. 1.
— — *B*	1	2	3	2	4	12	
Anthraceros albirostris (Bucerotidae)	1	2	2	2	4	11	
Columba domestica, *A*	1	2	4	2	4	13	
— — *B*	1	2	5[3]	2	4	14	[3] Nr. 1 mit deutlichem Ventralast.
— — *C*	1	2	4[3]	2	4	13	[3] Nr. 1 mit rudim. Ventralast links.
— — *D*	1	2	4	2	4	13	
Phlogoenas luzon.	2[1]	2	4[3]	2	5	15	[1] Nr. 1 ganz vor dem Ilium. [3] Nr. 1 links mit sehr dünnem Ventralast.

	Ia	Ib	II	III	IV	S	
Rapaces (Forts.)							
Scansores.							
Cuculus canorus, *A*	2[1]	2	2[3]	2	3	11	[1] Nr. 1 liegt fast ganz vor dem Ilium. Nr. 2 mit rückgebildeter fadendünner festgewachsener Rippe. [2] Ventralast an Nr. 1.
— — *B*	1	2	2[3]	2	3	10	[3] Dünner Ventralast an Nr. 1.
Picus martius	1	2	3	2	3	11	
— major	1	2	3	2	3	11	
— —	1	2	3	2	3	11	
— —	1	2	3	2	3	11	
— viridis, *A*	1	2	3	2	4	12	
— — *B*	2	2	3[3]	2	4	13	[3] Nr. 1 mit fadenförm. Ventralast.
Unbestimmter Papagei, *A* ..	3	2	2	2	4	13	
— — *B* ..	2	3	2	2	5	14	
Chrysotis versicolor	2	2	2	2	4	12	
Rhamphastus discolor	1	2	2[3]	2	5	12	[3] Nr. 1 mit schwachem Ventralast rechts.
— sp.	2	2	2	2	5	13	

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TAFELN

Tab. 1.

Gemeinsame Bezeichnungen: *ac* Acetabulum, *cr. il* Crista iliaca post., *fk* verknöcherte Fascie, *il* Os ilium, *o. is* Os ischii, *pu* Os pubis, *q* Querfortsatz, *qd* dorsaler, *qv* ventraler Ast eines Querfortsatzes, *r. il* Recessus iliacus, *wk* Wirbelkanal.

Fig. 1—5. Querschnitte des Kreuzbein-Beckens eines *Gallus domesticus*.

Fig. 1. Wirbel γ (der drittletzte Wirbel des I. Abschnittes) von hinten gesehen.

Fig. 2. Wirbel β von vorn gesehen.

Fig. 3. Wirbel α von vorn gesehen. Der Querfortsatz ist durch ein Loch in einen dorsalen und einen ventralen Ast gespalten.

Fig. 4. Vorletzter Wirbel des II. Abschnittes von hinten gesehen.

Fig. 5. Letzter Wirbel des II. Abschnittes von vorn gesehen.

Fig. 6. Querschnitt des Kreuzbein-Beckens von *Lagopus*. Wirbel α von hinten gesehen.

Fig. 7. Querschnitt des Kreuzbein-Beckens von *Gallus domesticus*.

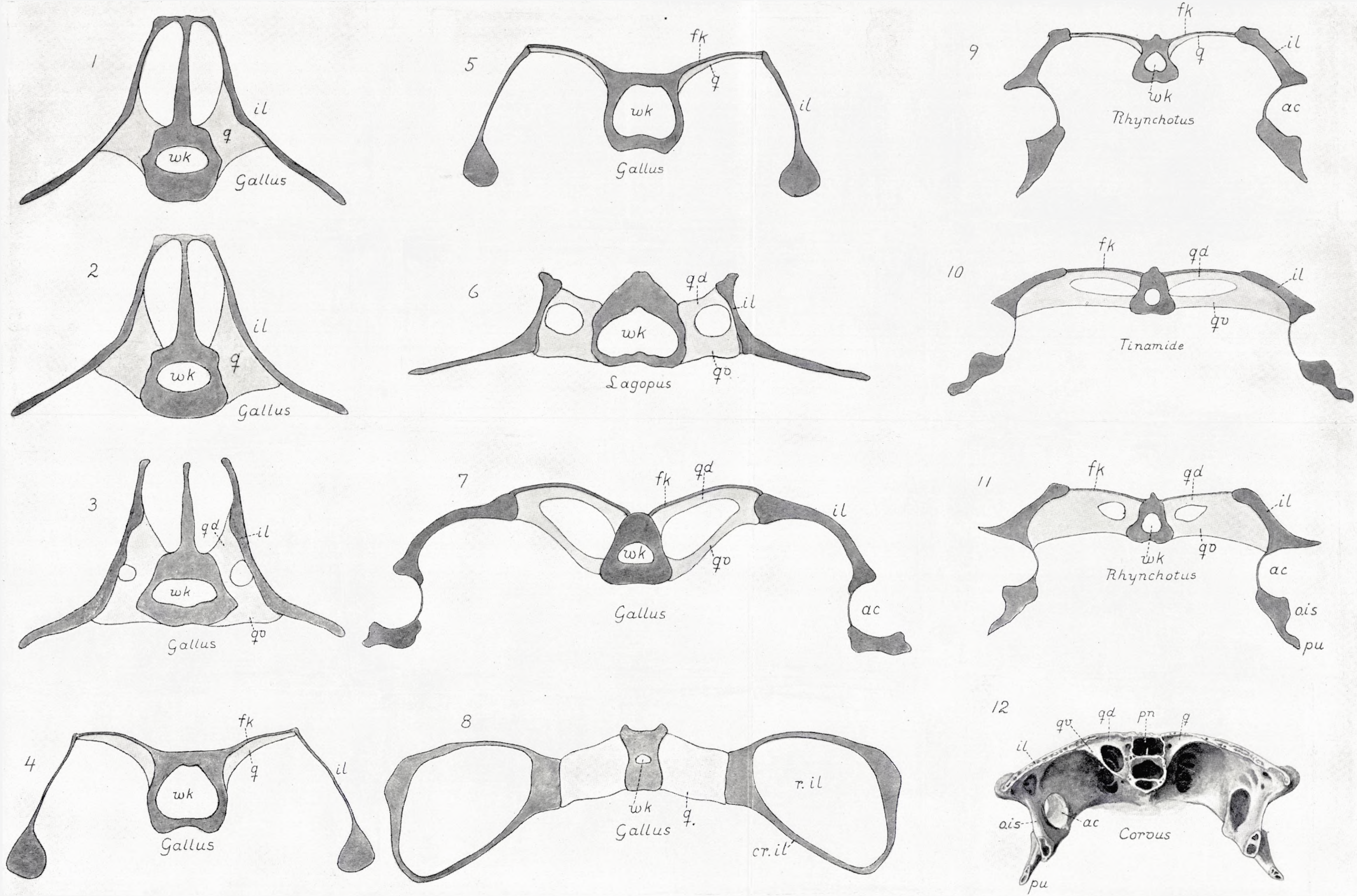
Fig. 8. Querschnitt durch das hintere Ende des Kreuzbein-Beckens von *Gallus domesticus*.

Fig. 9. Querschnitt durch das Kreuzbein-Becken eines *Rhynchotus rufescens*, von hinten gesehen. Der getroffene Wirbel ist der letzte Wirbel des II. Abschnittes.

Fig. 10. Querschnitt durch das Kreuzbein-Becken eines Tinamiden: Wirbel a von vorn gesehen.

Fig. 11. Dasselbe von *Rhynchotus rufescens*. Die zwei Äste des Querfortsatzes nur durch ein kleines Loch getrennt.

Fig. 12. Querschnitt des Kreuzbein-Beckens eines *Corvus*, von hinten gesehen. Der Schnitt geht durch den Wirbel *a*, an dem links ein wohlentwickelter Ventralast vorhanden ist, der rechts fehlt. *pn* pneumatischer Raum.



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Tab. 2.

Gemeinsame Bezeichnungen: *α—ε* Wirbel des I. Abschnittes. *1—5* Wirbel des II. Abschnittes. *a—b* Wirbel des III. Abschnittes. *c—g* Wirbel des IV. Abschnittes. — *ac* Acetabulum. *cr. d. l.* Crista dorso-lateralis. *cr. i.* Crista intermedia. *cr. o.* Crista obliqua. *cr. p.* Crista iliaca posterior. *do* Dornfortsätze. *f. i. is.* Foramen ilio-ischiad. *fk* verknöcherte Fascie. *il* Os ilium. *o. is.* Os ischii. *p. dis.* Pars dissaepta foram. obtur. *pr. t. is.* Processus terminalis ischiad. *pu* Os pubis. *qd* dorsaler, *qv* ventraler Ast eines Querfortsatzes. *wk* Wirbelkanal.

Fig. 1. Wirbel *α* des I. Abschnittes von *Rhynchotus rufescens* von hinten gesehen.

Fig. 2. Querschnitt des Kreuzbein-Beckens von *Grus paradisea* durch den Wirbel *a* und durch das Acetabulum. *l* Loch in der Fascien-Verknöcherung. *nl* doppeltes Nervenloch. Ein grosses pneumatisches Loch sieht man oberhalb des Wirbelkanals.

Fig. 3. Kreuzbein-Becken von *Aquila chrysaëtus* von der linken Seite, nat. Gr. Os pubis in zwei Stücke getrennt.

Fig. 4. Kreuzbein eines jungen Huhns von der linken Seite. Die Wirbel noch teilweise von einander (und von dem Becken) frei. Die Anheftungsflächen der Querfortsätze punktiert. *r* Gelenkfläche für eine Rippe.

Fig. 5. Kreuzbein und der erste freie Schwanzwirbel von *Alca torda* von der linken Seite. Bemerkenswert sind die grossen Anheftungsflächen der Querfortsätze der Wirbel *d* und *e*.

Fig. 6. Kreuzbein eines Nestjungen von *Buteo vulgaris* von der linken Seite. Die Wirbel *ε* und *ζ* waren rippentragend (*r*). Die Anheftungsflächen der Querfortsätze punktiert. *qq* sind die verschmolzenen Anheftungsflächen der Wirbel 3_{II}, *a*, *b*, *c*.

Fig. 7. Kreuzbein von *Spheniscus demersus*, ebenso. Anheftungsflächen punktiert.

Fig. 8. Kreuzbein von *Somateria mollissima* von der linken Seite und etwas von unten. *an* Anheftungsflächen der Querfortsätze. *qv* Ventralast von Wirbel 1_{II}.

Fig. 9. Kreuzbein-Becken von *Porphyrio coeruleus* von der rechten Seite, an welchem die rechte Beckenhälfte so weit abgelöst ist, wie sie nicht mit den Wirbeln verwachsen war, und weiter vorn abgebrochen (an dem cranialen Ende ist noch ein Stück Ilium vorhanden) *a* Ventralast des Wirbels *a*, der hier an der rechten Seite in der Mitte unterbrochen ist (an der anderen Seite ist er ganz). *a* + *b*, *c*, *d*, *e*, *f* Anheftungsflächen der Querfortsätze der Wirbel des III. und IV. Abschnittes. Die von *e* und *f* sind in je zwei geteilt.

Fig. 10. Die abgetrennte Beckenhälfte desselben von der Innenseite. *an* die Stellen, wo die Querfortsätze sich an das Ilium angeheftet haben. *br* Bruchstellen.

Fig. 11. Rechte Beckenhälfte von *Colymbus arcticus* (durch Mazeration abgelöst) von der Innenseite. Die Stellen (meist Gruben), wo die Querfortsätze der Kreuzbeinwirbel angeheftet gewesen, sind punktiert. *a'* Ansatzstelle des Querfortsatzes des Wirbels *a*, *b'* die von *b*, *α'* die des Wirbels *α*.

Fig. 12. Kreuzbein desselben Exemplars von der linken Seite. Man sieht die ausserordentlich verkürzten Querfortsätze.

Fig. 13. Rechte Beckenhälfte von *Charadrius squatarola* von der Innenseite. *an* Ansatzfläche des Querfortsatzes von *a*.

Fig. 14. Rechte Beckenhälfte von *Sterna minuta*, von der Innenseite. *an* Ansatzstellen der Querfortsätze der Kreuzbeinwirbel (die rechte ist die des Wirbels *a*).

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Tab. 3.

Gemeinsame Bezeichnungen: *α* letzter Wirbel des I. Abschnittes. *1—5* Wirbel des II. Abschnittes. *a—b* des III. Abschnittes. — *do* Dornfortsätze. *ba* Band. *f.ob* Foramen obturatorium. *il* Os ilium. *o. is* Os ischii. *pp* Processus praeacetabularis. *pu* Os pubis. *q* Querfortsatz. *se* verknöcherte Sehne.

Fig. 1. Kreuzbein-Becken von *Colymbus arcticus* von der linken Seite. Bemerkenswert ist es, dass der craniale Teil des Ilium *(il')* nicht wie gewöhnlich den oberen Rand der verschmolzenen Dornfortsätze des I. Abschnittes des Kreuzbeins erreicht.

Fig. 2. Stück des Kreuzbein-Beckens eines *Corvus cornix*, von der linken Seite, vergr. Die linke Hälfte ist abgebrochen, von derselben ist nur der dorsale Teil des Ilium übrig. *ne* doppeltes Nervenloch zwischen 1_{II} und 2_{II}. Zwischen demselben und dem entsprechenden zwischen 2_{II} und *a* sieht man zwei Gruben *ne'*, die offenbar die Andeutung eines doppeltes Nervenloches sind, die eine Oblitteration eines Wirbels anzeigen. Einziger derartiger beobachteter Fall.

Fig. 3. Kreuzbein und Teile des Beckens von einem 16 Tage alten *Gallus dom.*, von oben gesehen (die ventralen Äste der Querfortsätze der Wirbel *a* und *b* sind fortgelassen, nur die dorsalen Äste sind gezeichnet). Rechts und teilweise auch links sind die Querfortsätze der Wirbel 2_{II}—4_{II} und *a* und *b* abgegliedert.

Fig. 4. Kreuzbein und Teile des Ilium einer jungen *Limosa aegocephala* von oben gesehen. Querfortsätze der Wirbel 5_{II}, *a* und *b* abgegliedert.

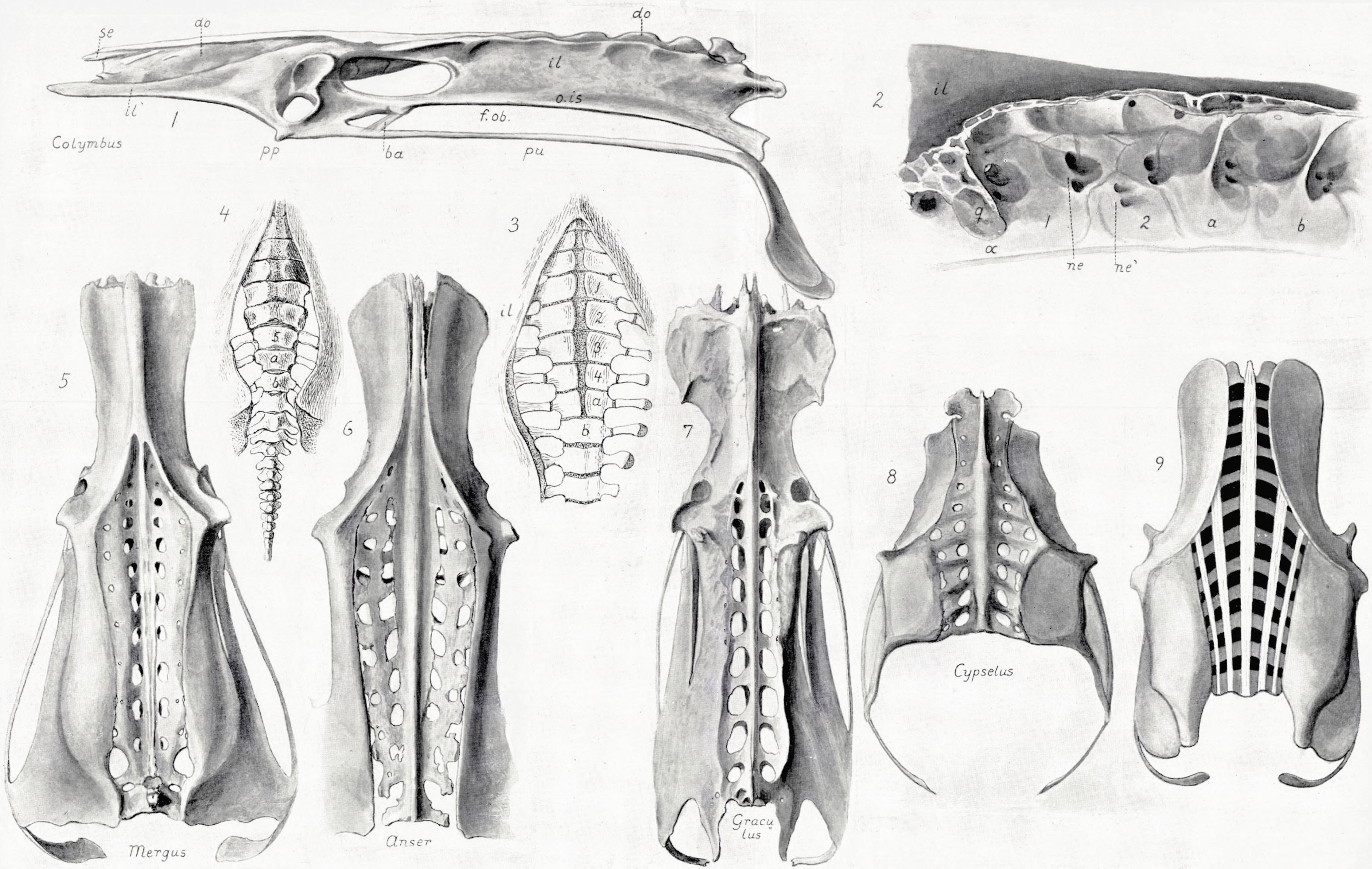
Fig. 5. Kreuzbein-Becken eines *Mergus merganser* von der Dorsalseite. In dem Feld zwischen den beiden Ilium-Rändern sind jederseits (rechts und links von der Mitte) drei Löcher-Reihen vorhanden, die laterale allerdings nur aus zwei Löchern rechts (einem links) bestehend.

Fig. 6. Dasselbe von *Anser cinereus*, ebenfalls mit drei Löcher-Reihen, die laterale vollständiger. (Pubis fortgelassen).

Fig. 7. Dasselbe von *Graculus (Phalacocorax) carbo*; nur zwei Löcher-Reihen jederseits, die mediale aus sehr grossen, die laterale aus wenigen, sehr kleinen Löchern bestehend.

Fig. 8. Dasselbe von *Cypselus apus*. Die Ossa ilium überdecken nicht wie bei den meisten Vögeln das craniale Ende des Kreuzbeins. Zwei Löcher-Reihen jederseits zwischen den Ilium-Rändern.

Fig. 9. Schema eines Vogelbeckens von der Dorsalseite. Die 5 hellen Streifen sind die Fascien, die verknöchern. Unterhalb derselben sieht man die Querfortsätze. Durch die Kombination der letzteren und der Fascien entsteht die in den vorhergehenden Figuren dargestellte durchlöcherte Knochenplatte.



Aut. dir., B. Strubberg del.

Tab. 4.

Gemeinsame Bezeichnungen: *α—ε* Wirbel des I. Abschnittes. *1—5* Wirbel des II. Abschnittes. *a—b* des III. Abschnittes. *c—g* des IV. Abschnittes. — *cr. i* Crista intermedia. *cr. o* Crista obliqua. *cr. p* Crista posterior. *o. is* Os ischii. *pp* Processus praeacetabularis. *pu* Os pubis.

Kreuzbein-Becken verschiedenen Vögel von der Ventralseite gesehen.

Fig. 1. *Lagopus.* Durch seine breite und offene Gestalt ausgezeichnet.

Fig. 2. *Ciconia alba.* Das Exemplar ist durch die Stärke des Ventralastes von *a* ausgezeichnet.

Fig. 3. *Ciconia alba.* Ventralast von *a* auf der rechten Seite schwach.

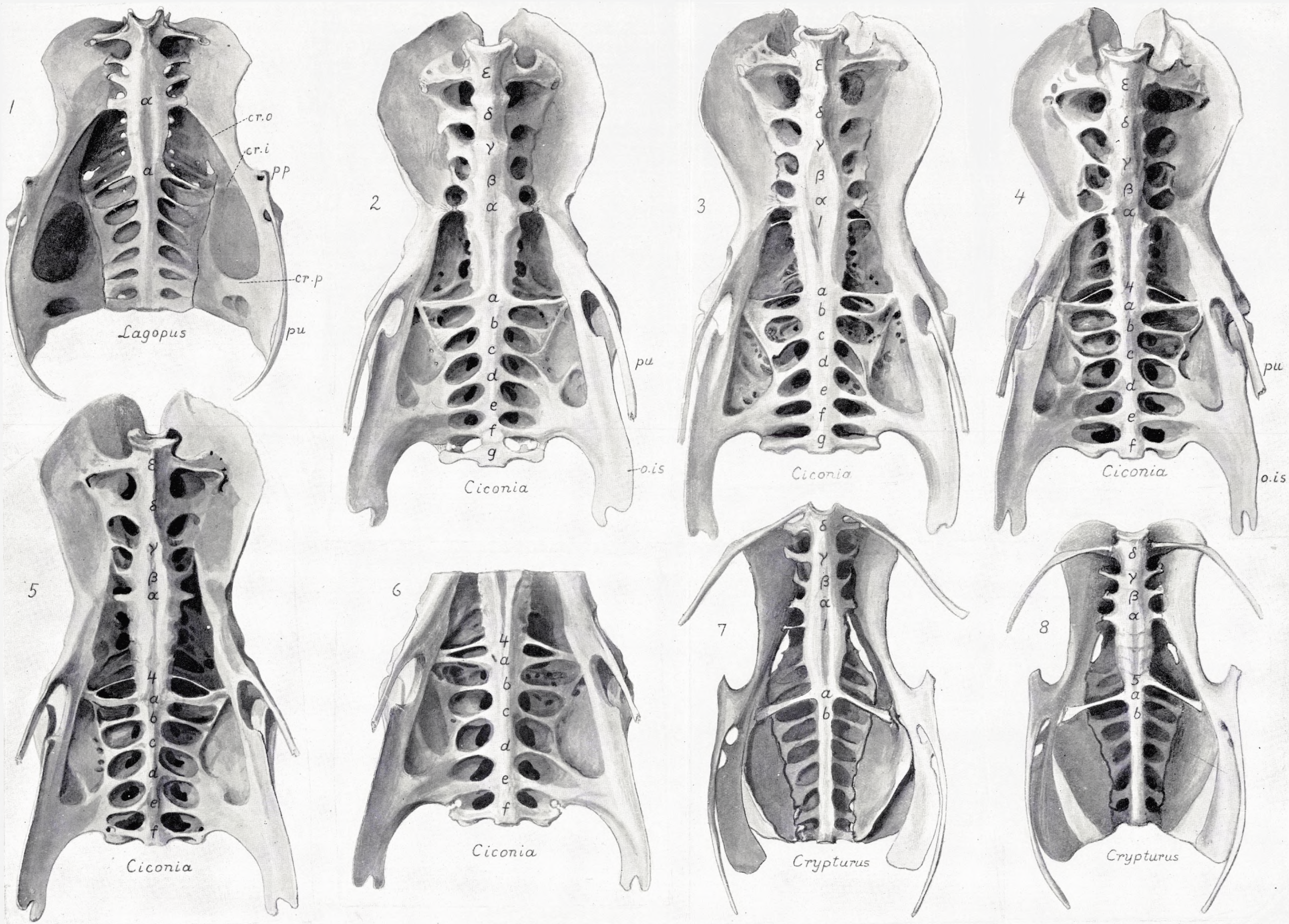
Fig. 4. *Ciconia alba.* Jederseits sehr schwacher Ventralast an 4_{II}.

Fig. 5. *Ciconia alba.* Ventralast von 4_{II} ähnlich wie bei Fig. 4. Der Ventralast des Wirbels *α* erreicht nicht das Ilium.

Fig. 6. *Ciconia alba.* Ventralast von 4_{II} jederseits stark entwickelt.

Fig. 7. *Crypturus obsoletus.* An dem Wirbel 1_{II} rechts ein wohlentwickelten Ventralast. Starker Ventralast jederseits am Wirbel *a*.

Fig. 8. *Crypturus obsoletus.* An dem Wirbel *a* nur an der rechten Seite ein Ventralast, an der linken keiner. Dagegen ist ein solcher und zwar ein sehr starker an dem vorangehendes Wirbel, 5_{II}, vorhanden.


1
α
α
cr.o
cr.i
pp
cr.p
pu
Lagopus
2
ε
δ
γ
β
α
a
b
c
d
e
f
g
pu
o.is
Ciconia
3
ε
δ
γ
β
α
1
a
b
c
d
e
f
g
Ciconia
4
ε
δ
γ
β
α
4
a
b
c
d
e
f
pu
o.is
Ciconia
5
ε
δ
γ
β
α
4
a
b
c
d
e
f
Ciconia
6
4
a
b
c
d
e
f
Ciconia
7
δ
γ
β
α
1
a
b
Crypturus
8
δ
γ
β
α
5
a
b
Crypturus

Tab. 5.

Gemeinsame Bezeichnungen: *α—δ* Wirbel des I. Abschnittes. *1—4* des II. Abschnittes. *a—b* des III. Abschnittes. *c—e* des IV. Abschnittes. — *cr. p* Crista posterior. *pp* Processus praeacetabularis. *p. t. i.* Processus terminalis ischiad. *pu* Os pubis.

Sämtliche Figuren sind Kreuzbein-Becken, resp. Kreuzbein allein, von der Ventralseite.

Fig. 1. *Rhamphastus discolor.* Ein unterbrochener Ventralast am 1_{II} auf der rechten Seite.

Fig. 2. *Rhamphastus sp.* Der Querfortsatz von 1_{II} ist überdeckt von dem grossen Ventralast von *α*. Ventralast von *b* ist unterbrochen auf der linken Seite.

Fig. 3. *Sturnus vulgaris.* An der linken Seite ein starker Ventralast an 1_{II}.

Fig. 4. *Sterna hirundo.* An diesem so wie an dem in Fig. 5 abgebildeten Präparat hat sich das Pubis durch das Trocknen von dem Os ischii entfernt.

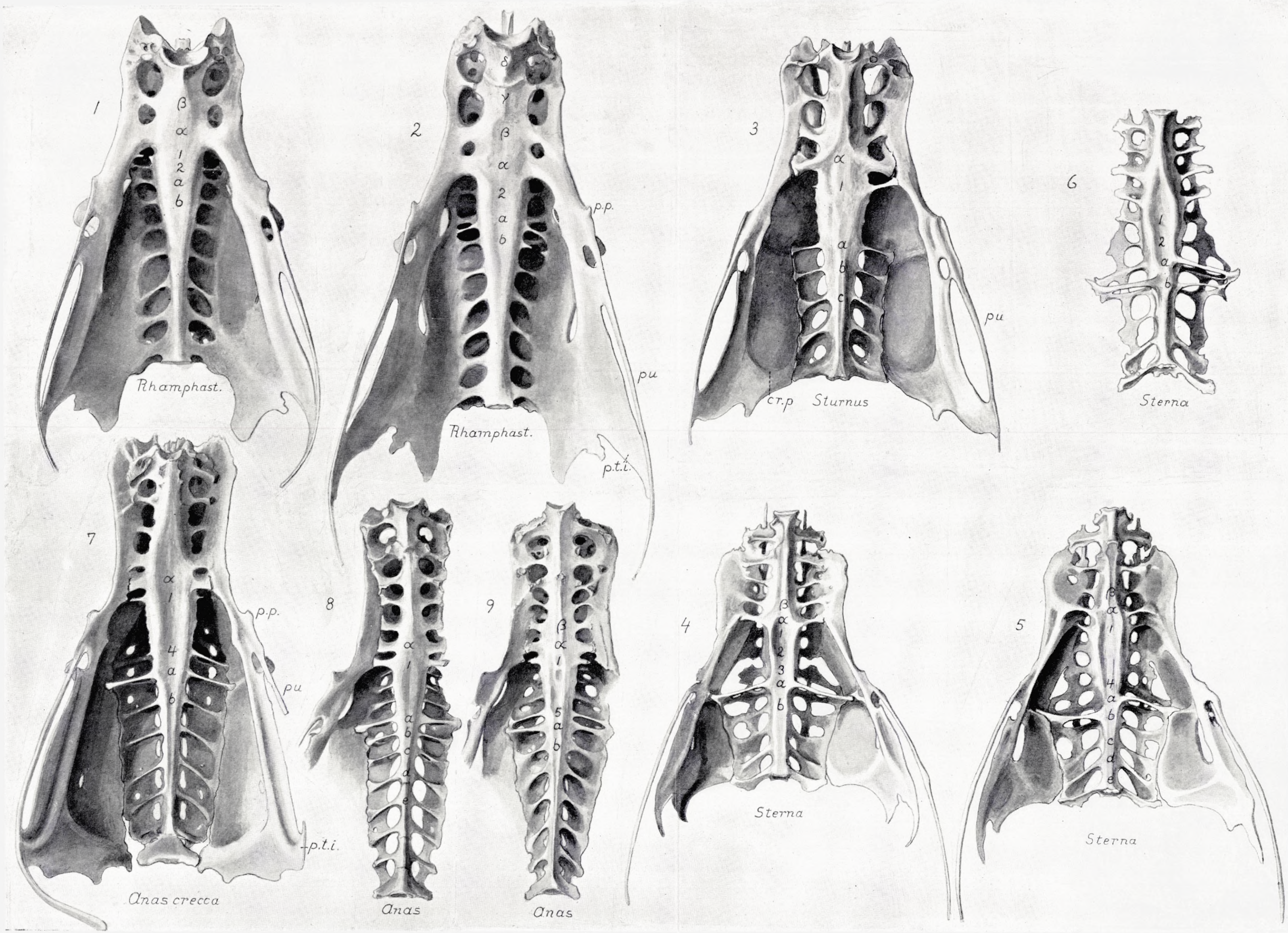
Fig. 5. *Sterna hirundo.* An der rechten Seite von 1_{II} ein starker Ventralast. Vergl. im übrigen p. 47.

Fig. 6. Kreuzbein von *Sterna minuta.* Vergl. p. 47.

Fig. 7. *Anas crecca.* Ventraläste an 1_{II} und 4_{II}. Os pubis teilweise abgebrochen.

Fig. 8. *Anas domestica.* Starke Ventraläste an 1_{II}. Becken grösstenteils entfernt.

Fig. 9. *Anas domestica.* Ventraläste an 1_{II} und 5_{II}.



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Tab. 6.

Gemeinsame Bezeichnungen: α—δ Wirbel des I. Abschnittes. *1—4* do. des II. Abschnittes. *a—b* do. des III. Abschnittes. *c—e* Wirbel des IV. Abschnittes. — *cr. i. p* Crista ischiadica post. *p* Os pubis. *q* Querfortsatz.

Kreuzbein-Becken, resp. Teile desselben von der Ventralseite.

Fig. 1. *Falco gyrfalco.* Ventralast rechts an 1_{II}.

Fig. 2. *Astur palumbarius.* Unterbrochene Ventraläste an 1_{II}.

Fig. 3. *Astur palumbarius.* Wohlentwickelte Ventraläste an 1_{II} und 5_{II}.

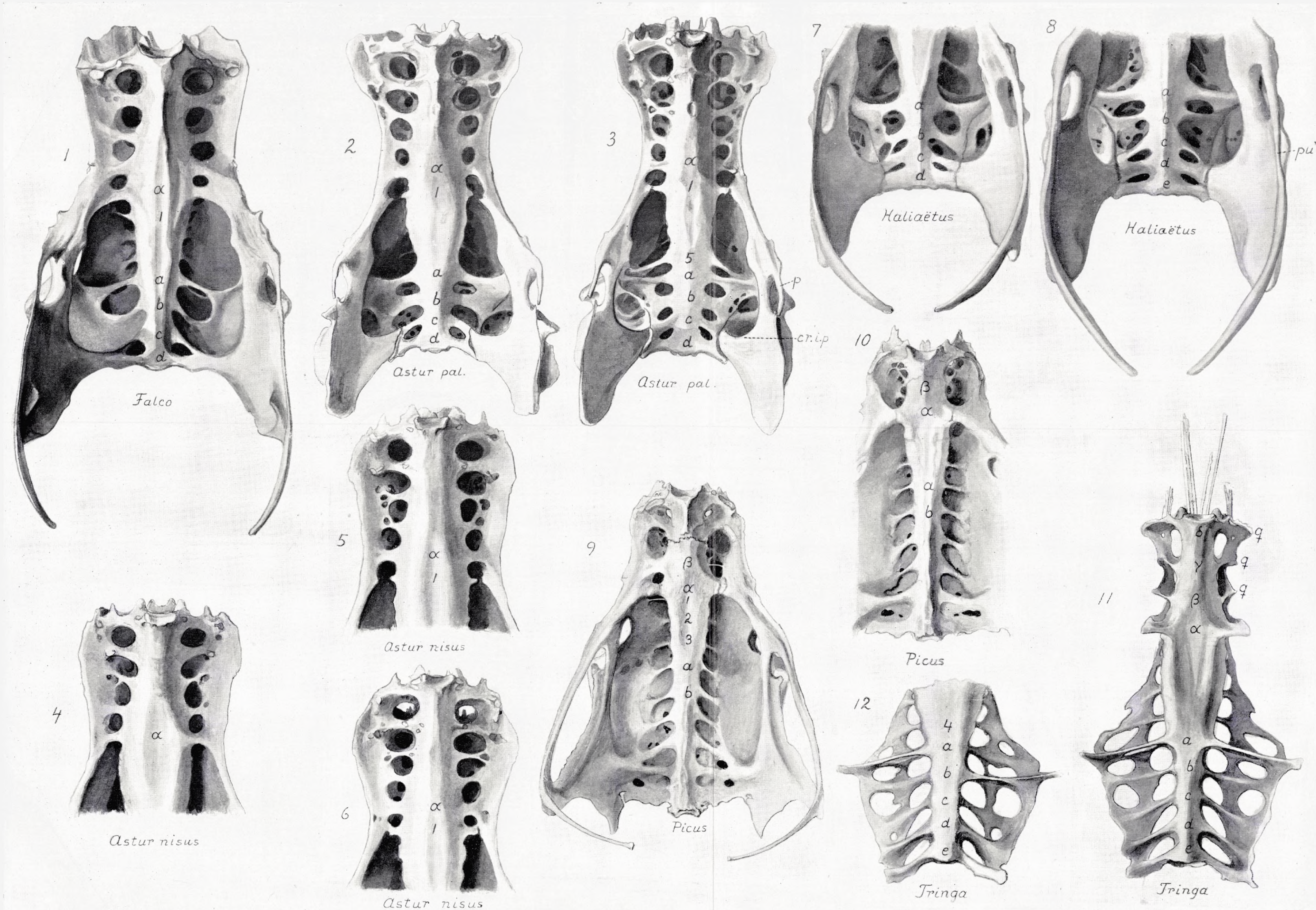
Fig. 4—6. Vorderster Teil des Kreuzbein-Beckens von drei verschiedenen Exemplaren von *Astur nisus.* Bei Fig. 4 ist an 1_{II} kein, bei Fig. 5 ein kleiner, bei Fig. 6 ein starker Ventralast jederseits vorhanden.

Fig. 7—8. Caudales Ende des Kreuzbein-Beckens zweier Exemplare von *Haliaëtus albicilla,* 7 mit nur zwei, 8 mit drei Wirbeln im IV. Abschnitt. *pu'* verdünnte Stelle des Pubis.

Fig. 9. *Picus viridis.* Dünner Ventralast rechts an 1_{II}. Der linke Querfortsatz vom Wirbel β ist ebenfalls fadenförmig.

Fig. 10. Kreuzbein und Teile des Beckens von einem anderen *Picus viridis.* Querfortsatz von β unregelmässig ausgebildet.

Fig. 11—12. Kreuzbein (an 12 nur das caudale Ende) von *Tringa alpina.* Bei 11 sind starke Ventraläste beiderseits an *a* entwickelt, keine an *b.* Bei 12 ist rechts ein starker Ventralast an *a,* links einer an *b* entwickelt.



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Tab. 7.

Gemeinsame Bezeichnungen: α—γ die Wirbel (resp. die Querfortsätze) des I. Abschnittes (α der hinterste). *1*—*2* Wirbel des II. Abschnittes. *a*—*b* die des III. Abschnittes. *c*—*e* die des IV. Abschnittes. — *do* Dornfortsatz. *do'* verwachsene Dornfortsätze. *g* Gruben. *il* Ilium. *o. is* Os ischii. *pd* Pars dissaepta for. obtur. *pp* Processus praeacetabularis. *pr. t. is* Processus terminalis ischiad. *pu* Os pubis. *q* Querfortsätze. *qd* dorsale Äste derselben. *sp. i. c* Spina ischiadica caudalis.

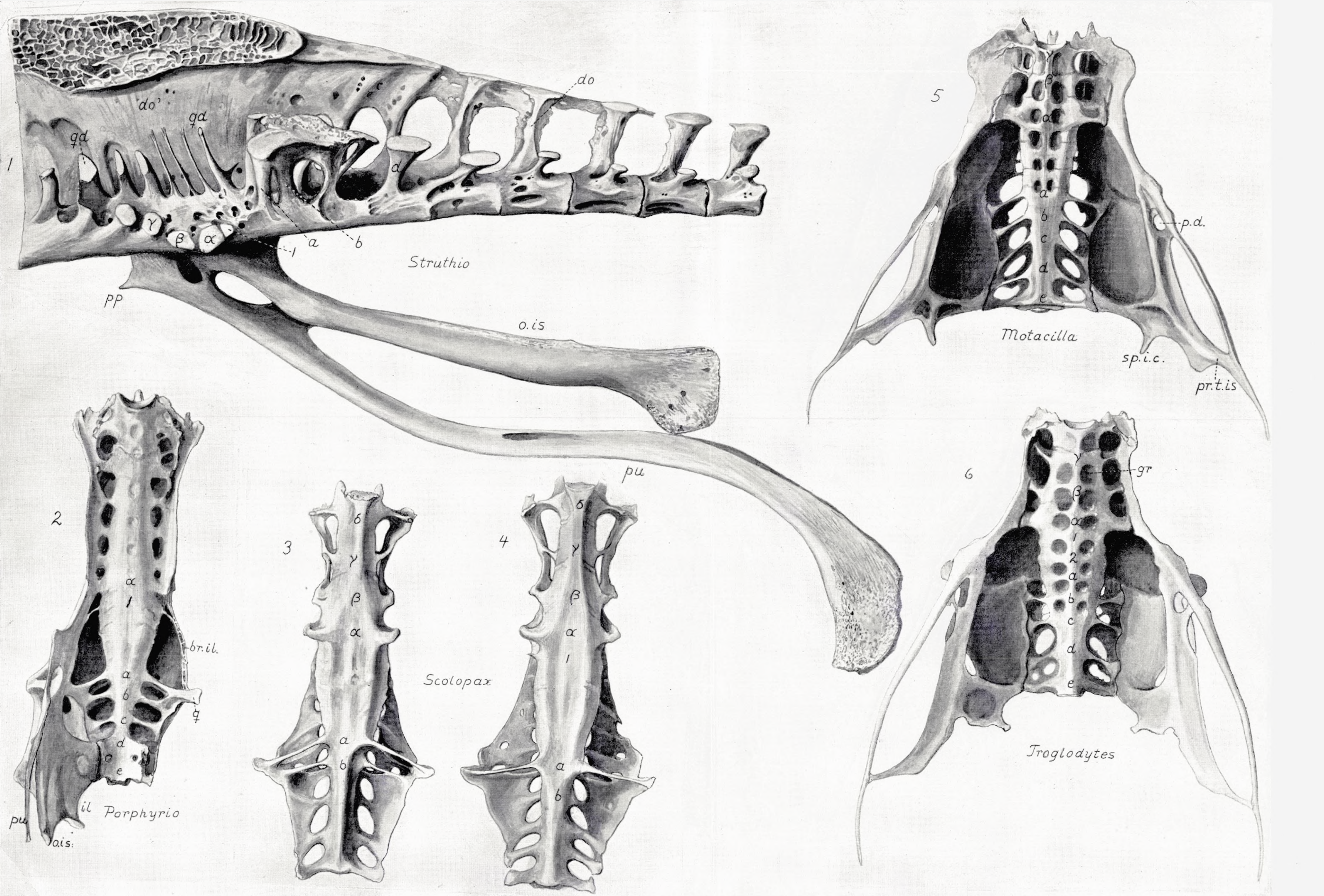
Fig. 1. Kreuzbein (das craniale Ende abgesägt) und Becken von *Struthio camelus*. Die linke Beckenhälfte ist abpräpariert, und von der rechten sind nur Os ischii und Os pubis gezeichnet. α, β, γ Anheftungsflächen der Ventraläste der Wirbel α, β, γ. 1 dieselbe von dem Wirbel 1_{II}; *a, b, d* dieselben von den Wirbeln *a, b* und *d*.

Fig. 2. Kreuzbein-Becken von *Porphyrio sp.* von der Ventralseite. Das caudale Ende der linken Beckenhälfte abgebrochen (*br. il* Bruchfläche des Ilium).

Fig. 3—4. Kreuzbeine zweier Exemplare von *Scolopax major*, von denen das linke sowohl an *a* wie an *b* wohlentwickelte Ventraläste hat, das andere aber nur an *a*.

Fig. 5. Kreuzbein-Becken von *Motacilla alba*. An der Unterseite der Wirbel der Abschnitte I und II paarige Gruben, dünnere Wandstellen des Rückgratkanals.

Fig. 6. Dasselbe von *Troglodytes parvulus*, ebenso. Die Gruben *(gr)* auch noch an den Wirbeln *a* und *b*.



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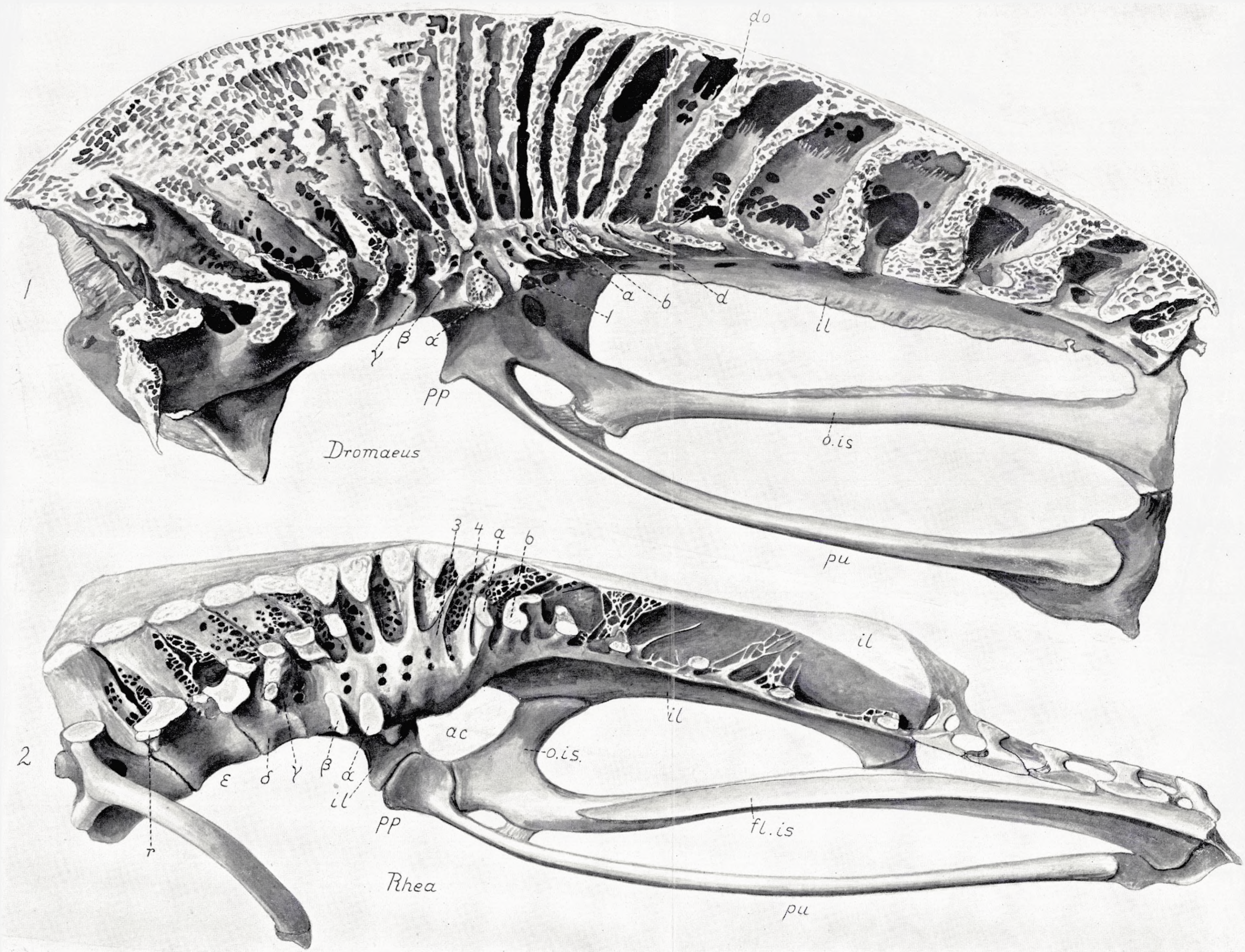
Tab. 8.

Gemeinsame Bezeichnungen: *α—ε* die Wirbel des I. Abschnittes. *1—4* die des II. Abschnittes. *a—b* des III. Abschnittes. *ac* Acetabulum. *d* zweiter Wirbel des IV. Abschnittes. *do* Dornfortsatz. *il* Ilium. *o.is* Os ischii. *pp* Processus praeacetabularis. *pu* Os pubis. *r* Gelenkfläche für die letzte, hier entfernte Rippe.

Fig. 1. Kreuzbein-Becken von *Dromaeus Novae Hollandiae* von der linken Seite. Die linke Beckenhälfte ist abpräpariert. Die Striche von den Wirbelnummern gehen überall nach den Querfortsätzen. (Zwischen den Dornfortsätzen sieht man dünne Knochenplatten, Verknöcherungen von Bindegewebeplatten).

Fig. 2. Dasselbe einer jungen *Rhea,* von der linken Seite. Die linke Beckenhälfte weggenommen. Die Striche von den Wirbelnummern gehen (mit Ausnahme von dem von *δ*) überall nach den Querfortsätzen. *fl.is* Fläche des rechten Os ischii, an welche sich eine entsprechende des linken angelegt hat.



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Tab. 9.

Gemeinsame Bezeichnungen: α—ε (in den Figg. 2—6) Wirbel des I. Abschnittes; *a* in 2—6 Wirbel *a* (Nr. 1 des III. Abschnittes). *cr* die dem Cruralplexus entstammenden Nerven. *1c—4c* die Wurzeln des Cruralplexus. *1i—5i* die Wurzeln des Plexus ischiadicus. *is* Nervus ischiadicus. *ob* Nervus obturatorius. — *il* Ilium. *o.is* Os ischii. *pu* Os pubis.

Fig. 1. Plexus lumbo-sacralis von einem *Alligator* in situ von der Ventralseite. Das Becken ist ventral in der Mitte durchschnitten und die Hälften (deren ventrale Teile fortgelassen sind) seitlich gezwungen. α—γ die drei letzten Lumbarwirbel. *1—2* die beiden Sacralwirbel. *a* der erste Schwanzwirbel.

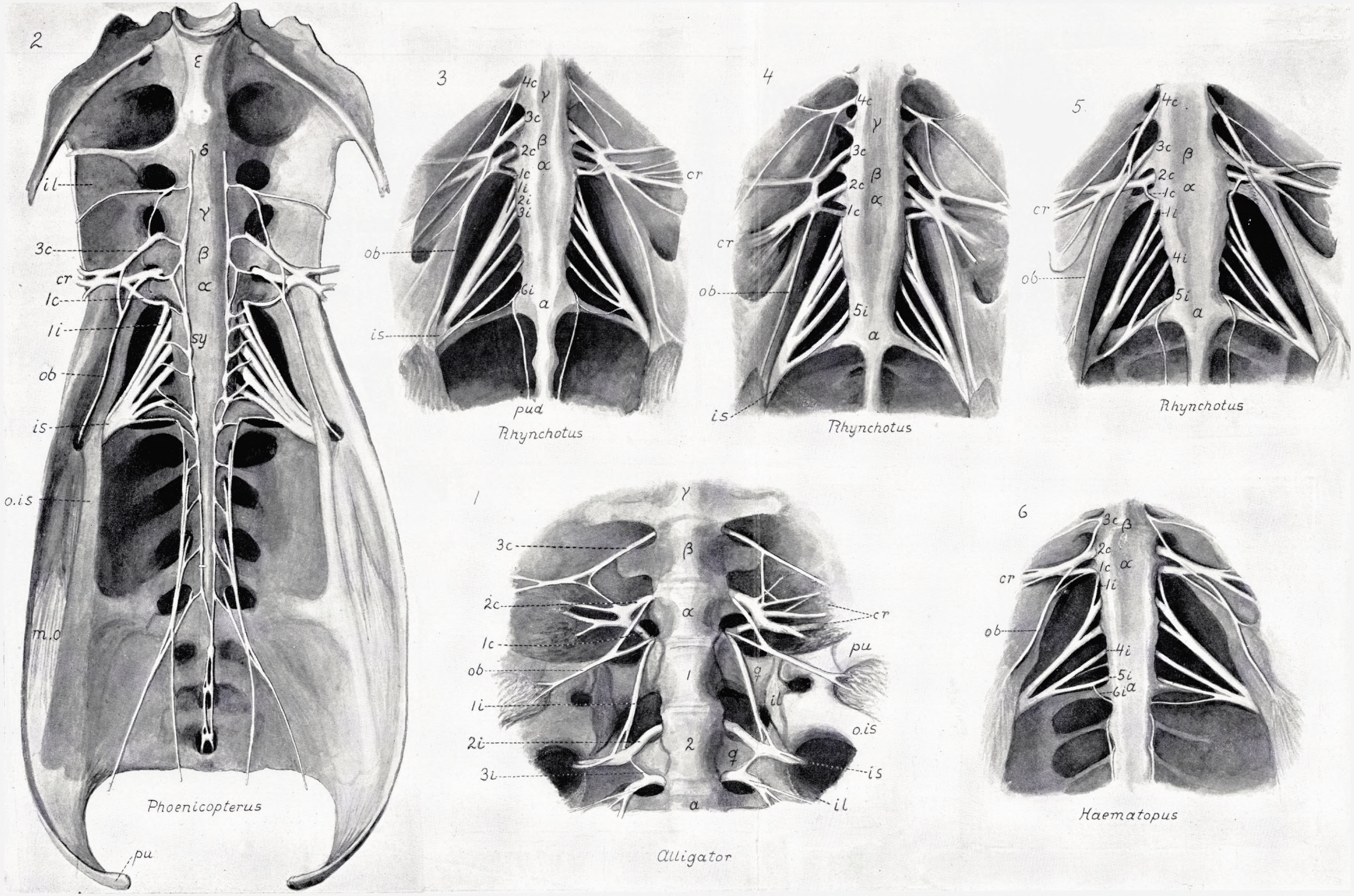
Fig. 2. Plexus lumbo-sacralis und der Nervus sympathicus der Beckenregion von einem *Phoenicopterus*. Man sieht den Sympathicus *(sy)* mit seinen Ganglien und deren Verbindungsäste mit den Wurzeln des Plexus lumbo-sacralis. In der unteren Hälfte der Figur sieht man in der Mitte die beiden Sympathici und rechts und links die Plexus pudendi. *mo* Musculus obturat.

Fig. 3. Plexus lumbo-sacralis von einem *Rhynchotus rufescens,* der sich dadurch auszeichnet dass die Wurzel *1c* sich auf der linken Seite vor der Verbindung mit *2c* in zwei Äste spaltet. Weiter ist eine *6i* vorhanden, die bei den anderen Exemplaren der Art fehlt.

Fig. 4. Dasselbe von einem anderen *Rhynchotus rufescens.*

Fig. 5. Dasselbe von einem dritten Exemplar derselben Art, das sich dadurch auszeichnet, dass *1c* quer über den Querfortsatz von α verläuft, bevor sie sich mit dem *2c* vereinigt, während sie bei den Exemplaren Fig. 3 und 4 ganz caudal von dem Querfortsatz liegt.

Fig. 6. Dasselbe von *Haematopus ostralegus* (typisch). Vor dem Nervenwurzel *5i* sieht man auf der rechten Seite einen Ventralast des letzten Wirbels des II. Abschn. (nicht bezeichnet). Die Nervenwurzel *6i* entspringt caudal von Wirbel *a* (in Fig. 3 dagegen vor demselben) und verbindet sich auf der rechten Seite mit *5i* nicht weit von dem Ursprung der letzteren, auf der linken Seite dagegen in gewöhnlicher Weise weiter lateral.



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Tab. 10.

Gemeinsame Bezeichnungen: α—β Wirbel des I. Abschnittes. *1*—*5* die des II. Abschnittes. *a*—*b* des III. Abschnittes. *1c*—*3c* die Wurzeln des Cruralplexus. *1i*—*6i* die des Plexus ischiad. *cr* die dem Cruralplexus entstammenden Nerven. *is* Nervus ischiad. *ob* N. obturatorius. *pud* Plexus pudendus.

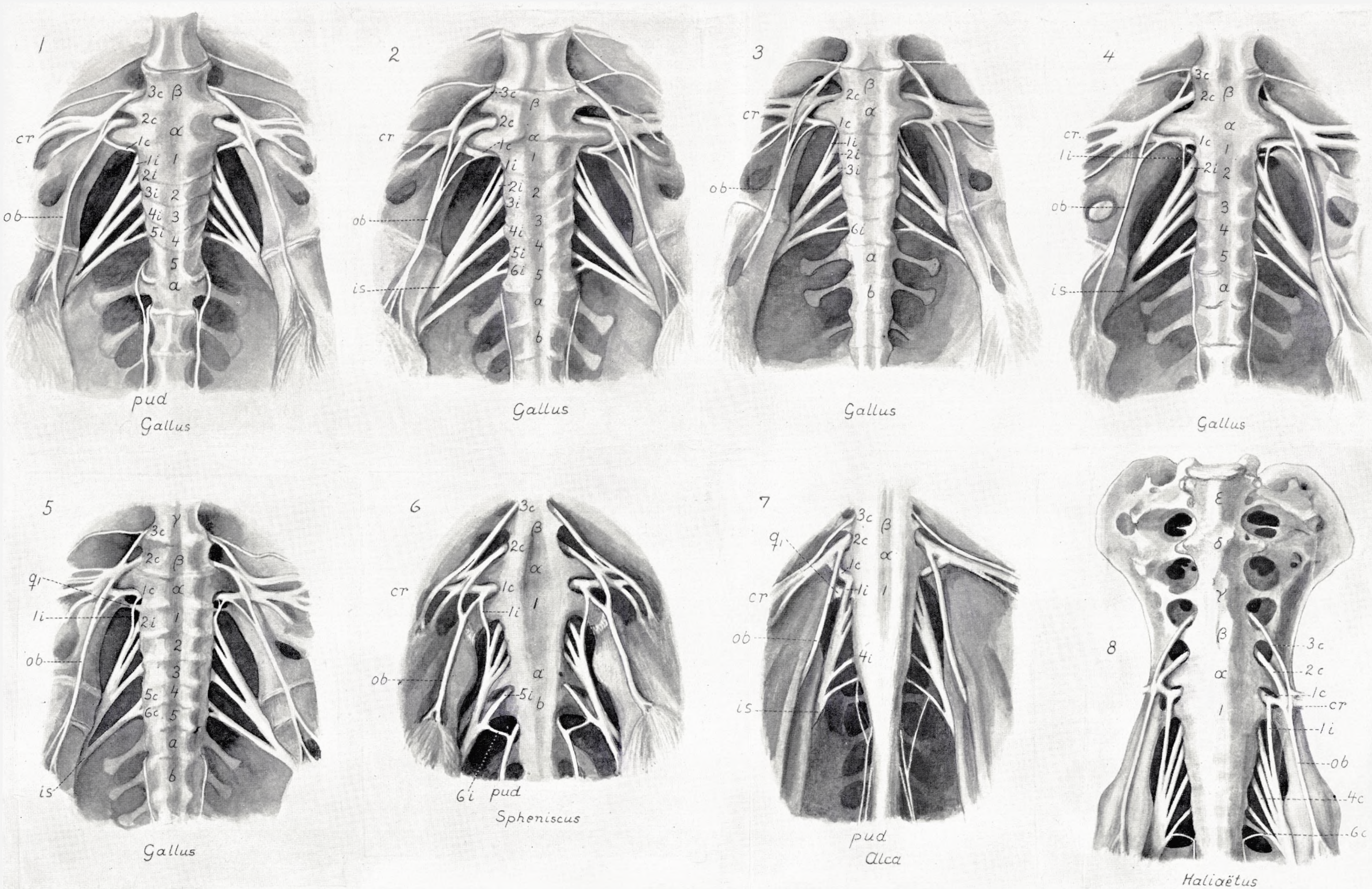
Alle auf dieser Tafel abgebildeten Plexus gehören der typischen Form an (möglicherweise mit Ausnahme von Fig. 5).

Fig. 1—5. Plexus lumbo-sacralis von 5 Kücken (Gallus dom., pull.), die alle etwas verschieden sind. Alle haben 6 Ischiadicus-Wurzeln mit Ausnahme von Fig. 1. In Fig. 4 und 5 ist an 1_{II} ein dünner Ventralast (q_1) vorhanden, der bei den anderen fehlt. Der N. obturatorius entspringt bei 2 und 3 (rechts) mit drei Wurzeln, sonst nur mit zwei. Die *1i* verbindet sich in Fig. 4 in eigenartiger Weise mit *1c*. In Fig. 5 spaltet sich *1i* auf der linken Seite vor der Verbindung mit *1c* in zwei Äste, was möglicherweise auf das Vorhandensein von einer mit *1i* verwachsenen *Oc* deuten könnte (vergl. p. 31—32).

Fig. 6. Dasselbe von *Spheniscus demersus*. Das Präparat zeichnet sich durch die ausserordentliche Stärke des Ventralastes von 1_{II} aus (ebenso bei einem anderen Exemplar). In Bezug auf die Nerven ist der Fall aber durchaus typisch.

Fig. 7. Dasselbe von *Alca torda*. An 1_{II} ist ein Ventralast rechts vorhanden.

Fig. 8. *Haliaëtus albicilla*. Starker Ventralast jederseits an 1_{II} und ein schwacher an 5_{II} links.



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Tab. 11.

Gemeinsame Bezeichnungen: *α—γ* Wirbel des I. Abschnittes. *1* erster Wirbel des II. Abschnittes. *a—b* Wirbel des III. Abschnittes. *1c—3c* Wurzeln des Cruralis-Plexus. *Oi—5i* Wurzeln des Plexus ischiad. *cr* dem Cruralplexus entstammende Nerven. *is* N. ischiad. *ob* N. obturat. *pud* Plexus pudendus.

Sämtliche auf dieser Tafel abgebildete Plexus sind solche, die mit einer überzähligen Ischiadicus-Wurzel, *Oi,* versehen sind.

Fig. 1. *Picus viridis.*

Fig. 2. *Picus major. 1c* fehlt. Nur vier Ischiadicus-Wurzeln ausser *Oi.*

Fig. 3. *Corvus frugilegus, pull.*

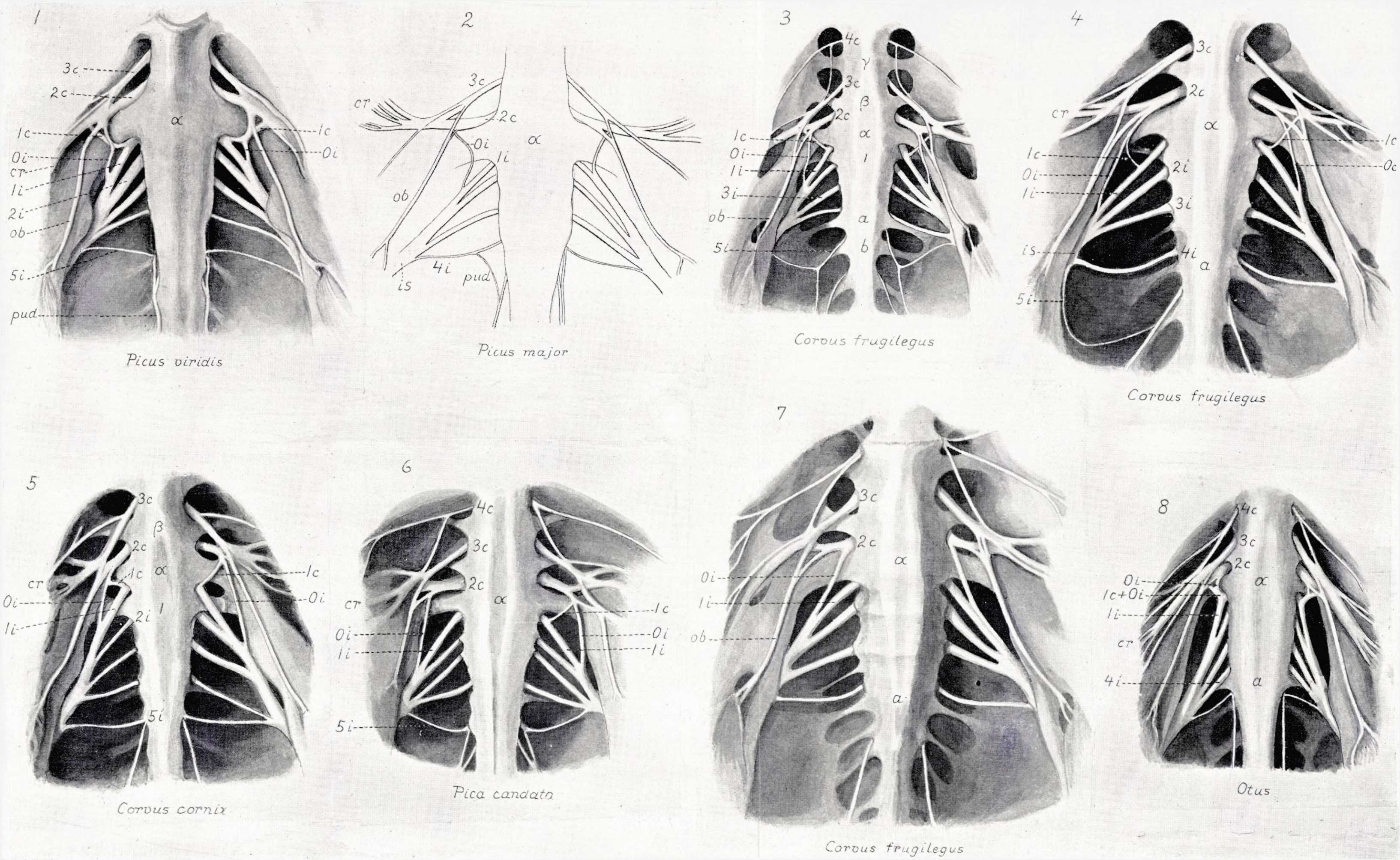
Fig. 4. — — —

Fig. 5. *Corvus cornix.*

Fig. 6. *Pica caudata. 1c* fehlt auf der rechten Seite.

Fig. 7. *Corvus frugilegus. 1c* fehlt beiderseits.

Fig. 8. *Otus brachyotus.*



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Tab. 12.

Gemeinsame Bezeichnungen: *α—δ* Wirbel des I. Abschnittes. *1—4* die des II. Abschnittes. *a—b* die des III. Abschnittes. *1c—3c* die Wurzeln des Plexus cruralis. *Oi—4i* die des Plexus ischiad. *cr* Cruralis-Nerven. *ob* N. obturat.

In den meisten der hier abgebildeten Plexus ist ein *Oi* vorhanden.

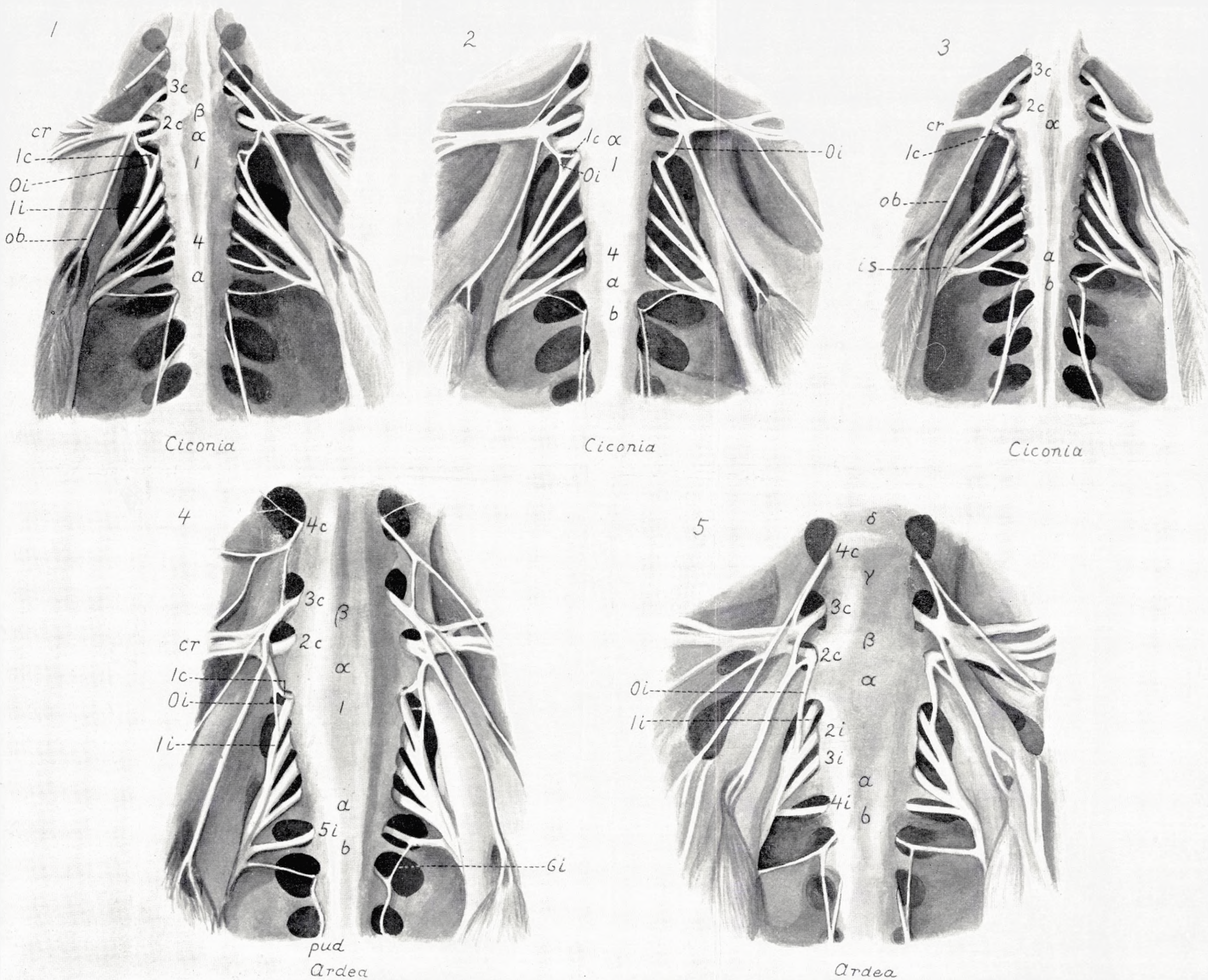
Fig. 1. *Ciconia alba.* *Oi* und *1c* beiderseits.

Fig. 2. — — *Oi* beiderseits, *1c* nur auf der rechten Seite.

Fig. 3. — — *Oi* fehlt.

Fig. 4. *Ardea cinerea.* *Oi* und *1c* beiderseits vorhanden. Ventralast (links schwach) auf 1_{II}.

Fig. 5. *Ardea cinerea.* *Oi* beiderseits vorhanden. *1c* beiderseits fehlend.



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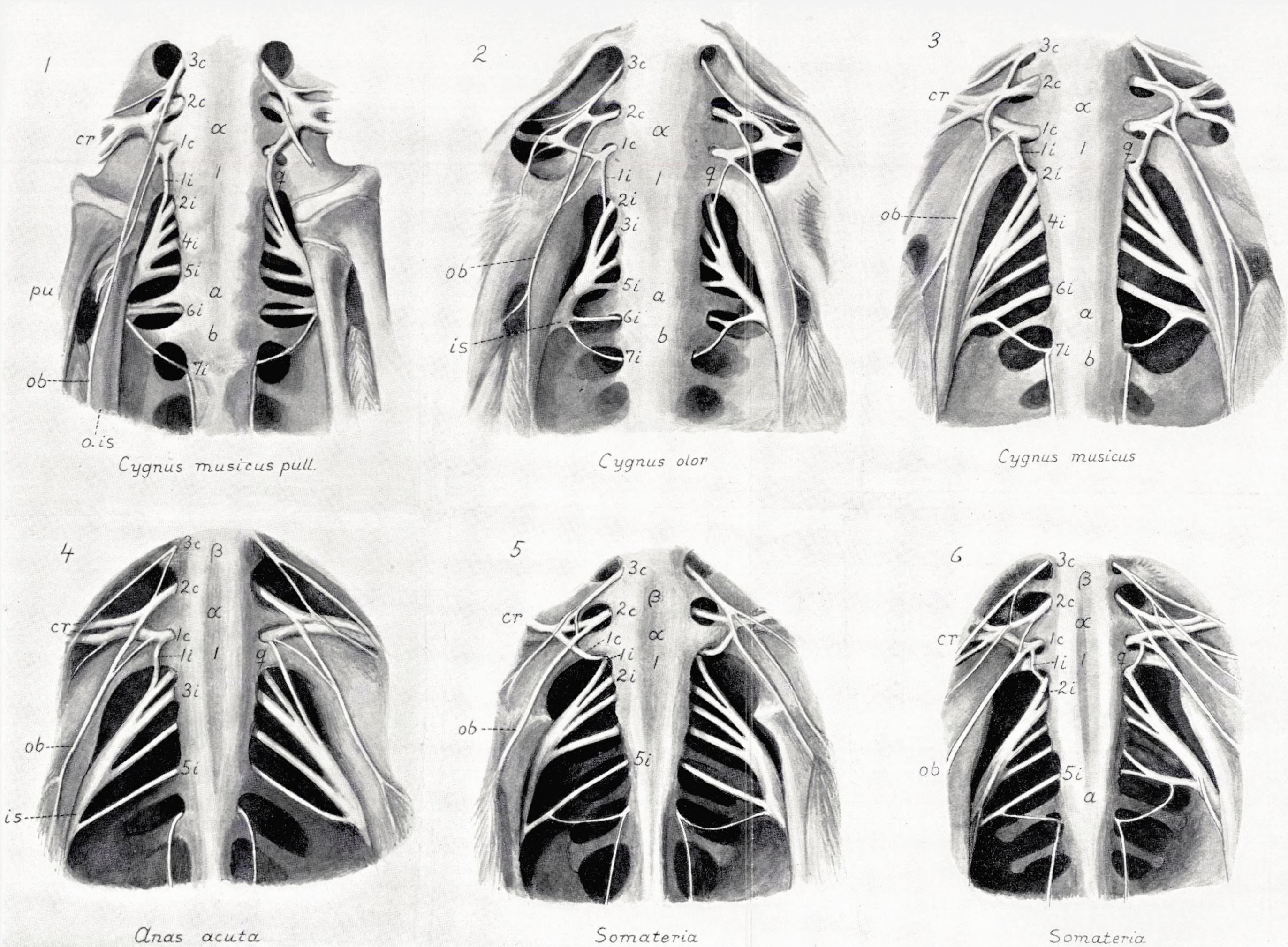
Tab. 13.

Gemeinsame Bezeichnungen: *α*, *β* die zwei letzten Wirbel des I. Abschnittes. *1* erster Wirbel des II. Abschnittes. *a*, *b* Wirbel des III. Abschnittes. *1c*—*3c* Wurzeln des Plexus cruralis. *1i*—*7i* Wurzeln des Plexus ischiad. *cr* Cruralnerven. *is* N. ischiadicus. *ob* N. obturat. *q* Querfortsatz des 1_{II}.

Sämtliche Figuren dieser Tafel mit Ausnahme von Fig. 5 zeichnen sich dadurch aus, dass 1_{II} mit einem starken Querfortsatz versehen ist, der dem von *α* ungefähr gleichkommt.

Fig. 1. *Cygnus musicus*, pull.
Fig. 2. *Cygnus olor*.
Fig. 3. *Cygnus musicus*, ad.
Fig. 4. *Anas acuta*.
Fig. 5—6. *Somateria mollissima*.



1 Cygnus musicus pull. 2 Cygnus olor 3 Cygnus musicus

4 Anas acuta 5 Somateria 6 Somateria

Aut. dir., B. Strubberg del.

Tab. 14.

Gemeinsame Bezeichnungen: *α—γ* Wirbel des I. Abschnittes. *1—5* Wirbel des II. Abschnittes. *a, b* Wirbel des III. Abschnittes. *Oc—3c* Wurzeln des Plexus cruralis. *1i—6i* die des Plexus ischiad. *cr* Cruralnerven. *is* N. ischiadicus. *ob* N. obturat. *q* Ventralast des Querfortsatzes von 1_{II}.

Fig. 1. Lumbo-sacral-Plexus von *Tetrao urogallus*. Ganz der gewöhnliche Vogel-Typus.

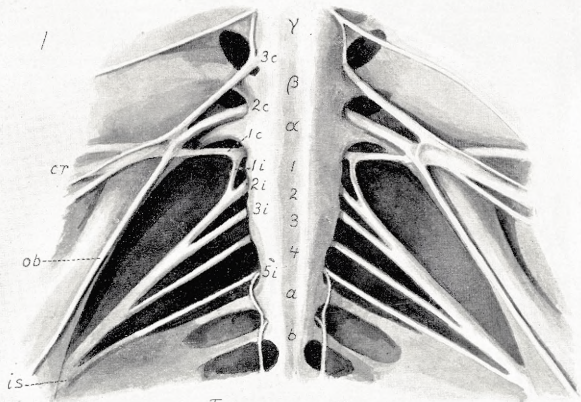
Fig. 2. Dasselbe von einem anderen Exemplar derselben Art. Zeigt den gewöhnlichen Fall bei dieser Art: eine überzählige Cruralis-Wurzel *Oc* zwischen den Wirbeln 1_{II} und 2_{II} vorhanden, während *1i* fehlt (Auerhahn-Typus).

Fig. 3. Dasselbe von einem *Totanus glottis*. Ganz der gewöhnliche Vogel-Typus.

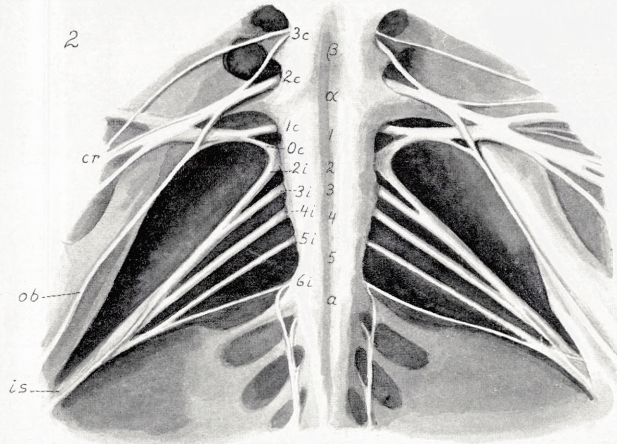
Fig. 4. Dasselbe von einem *Totanus fuscus*. Ebenfalls der gewöhnliche Vogel-Typus, *1i* ist jedoch schwach. Am 1_{II} ein Ventralast vorhanden.

Fig. 5. Dasselbe von einem *Totanus calidris:* Auerhahn-Typus, *Oc* beiderseits vorhanden. An der linken Seite auch eine *1i*, verbunden mit *Oc*.

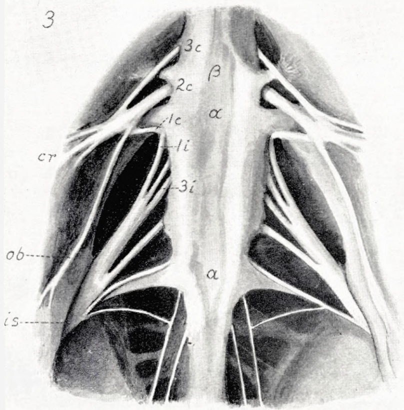
Fig. 6. Dasselbe von einem *Totanus fuscus*. An der rechten Seite dasselbe Bild wie in Fig. 5 auf der linken Seite. Auf der linken Seite nur ein einfacher Nerv, der als *1i* gedeutet wurde.



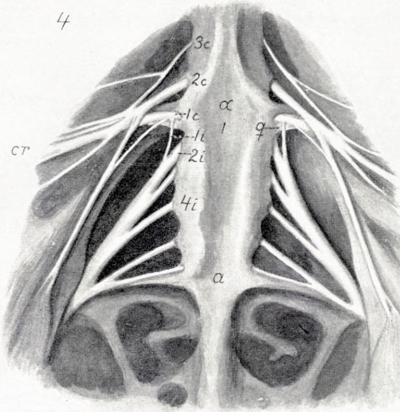
Tetrao urogallus



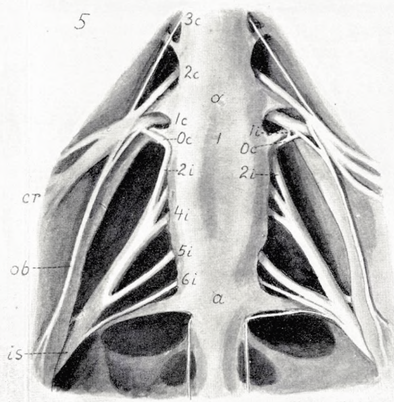
Tetrao urogallus



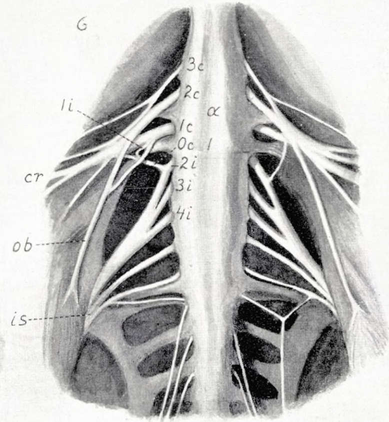
Totanus



Totanus



Totanus



Totanus

Aut. dir., B. Strubberg del.

Tab. 15.

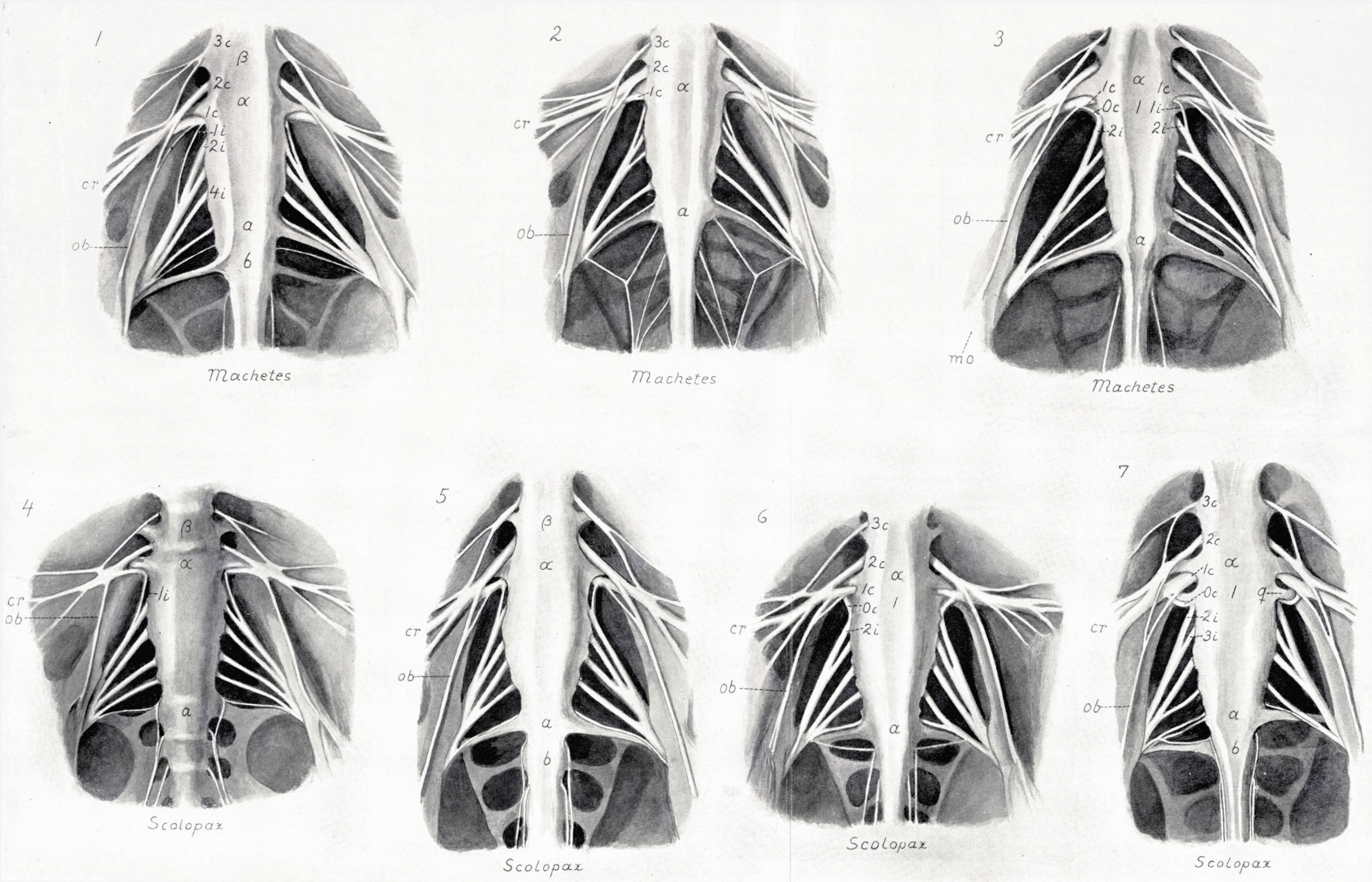
Gemeinsame Bezeichnungen: *α*, *β* die zwei letzten Wirbel des I. Abschnittes. *1* erster Wirbel des II. Abschnittes. *a*, *b* die Wirbel des III. Abschnittes. *Oc—3c* Wurzeln des Plexus cruralis. *1i—4i* Wurzeln des Plexus ischiad. *cr* Cruralnerven. *mo* Musc. obtur. *ob* N. obturat. *q* Querfortsatz von 1_{II}.

Fig. 1—2. Lumbo-sacral-Plexus von *Machetes pugnax*. Beide typisch. In Fig. 1 ist *1i* auf der rechten Seite ungemein dünn und in den zwei Figuren entspringt der N. obturat. in verschiedener Weise, in Fig. 1 von *1c* und *2c*, in Fig. 2 von *2c* und *3c*.

Fig. 3. Dasselbe von einem dritten *Machetes pugnax*. Auf der rechten Seite ist eine *Oc*, aber keine *1i* vorhanden, auf den linken Seite *1i*, aber keine *Oc* vorhanden.

Fig. 4—5. Dasselbe von *Scolopax gallinago*. Der gewöhnliche Vogel-Typus. Abgebildet weil der N. obtur. in verschiedener Weise bei den zwei Exemplaren entspringt.

Fig. 6—7. Dasselbe von zwei anderen Exemplaren von *Scolopax gallinago:* Auerhahn-Typus, ganz wie Auerhahn Tab. 14 Fig. 2. — In der Fig. 7 ist ein starker Ventralast am 1_{II} vorhanden (*q*), was ich bei keinen Auerhahn fand.



Aut. dir., B. Strubberg del.

Det Kongelige Danske Videnskabernes Selskab.

Skrifter, naturvidenskabelig og mathematisk Afdeling.

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ÉTUDES
SUR
LES PÉLÉCYPODES ET GASTROPODES DANIENS
DU CALCAIRE DE FAXE

PAR

J. P. J. RAVN

AVEC 7 PLANCHES

D. Kgl. Danske Vidensk. Selsk. Skrifter, naturv. og math. Afd., 9. Række, V. 2.

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Au cours des années écoulées depuis la publication de mes études sur les mollusques des dépôts crétaciques de Danemark (14), les matériaux nouveaux de mollusques du Calcaire de Faxe se sont augmentés sur une très vaste échelle. On a, certes, recueilli bon nombre de nouveaux exemplaires des espèces décrites auparavant, mais ce sont principalement des espèces, pour la plus grande part inconnues jusqu'ici, de petits pélécypodes et gastropodes qui ont augmenté la collection et qui, souvent, ont été trouvés en un très grand nombre d'individus. Tous ces matériaux, qui sont incorporés dans les collections du Muséum de Minéralogie et de Géologie de l'Université, ont été fournis notamment par M. le Dr. K. Brünnich Nielsen, médecin major, M. le Dr. Chr. Poulsen, et M. A. Rosenkrantz, chargé de cours à l'École polytechnique de Copenhague. Je suis très reconnaissant à ces messieurs de l'obligeance avec laquelle ils m'ont laissé les fossiles recueillis par eux pour mon étude. Pour ma part, j'ai également pu faire des récoltes assez considérables. Au cours de mes études j'ai constaté qu'un grand nombre des espèces était très rapproché d'éspèces du Paléocène et de l'Éocène de Belgique et de France; une comparaison directe avec ces espèces était donc indispensable. Grâce à une subvention de la part de la fondation Carlsberg, à laquelle je tiens à exprimer ici ma reconnaissance de me l'avoir accordée, j'ai pu, dans ce but, faire un voyage pour visiter les musées belges et français. Ce sont surtout les riches collections de l'Institut géologique de la Sorbonne, du Musée Royal d'Histoire naturelle de Belgique, et de l'École des Mines à Mons, qui ont été d'une grande valeur pour mes études. Pour l'appui empressé que j'ai trouvé dans ces musées j'ai bien des obligations à Messrs. les directeurs des musées, M. le professeur, Dr. Ch. Jacob à Paris, M. le professeur, Dr. V. Van Straelen à Bruxelles, et le défunt professeur, Dr. J. Cornet à Mons. Je m'empresse de remercier ici encore la fondation Rask-Ørsted pour avoir bien voulu se charger des frais de traduction du présent travail, et la fondation Carlsberg, qui a fourni les subsides nécessaires pour la production des illustrations indispensables à un travail de cette nature. La production des illustrations par voie photographique a été assez difficile, tant à cause de la couleur blanche des fossiles qu'à cause de leurs dimensions minuscules, qui, dans la plupart des cas, ont nécessité une reproduction agrandie. M. le Dr. Chr. Poulsen a fait preuve de sa supériorité habituelle en s'acquittant de cette tâche délicate.

A. Remarques sur l'état de conservation et la provenance des fossiles.

On sait que dans toutes les roches calcaires d'un certain âge les tests composés d'aragonite sont décomposés, tandis que les tests de calcite sont conservés. En ce qui concerne le calcaire de Faxe ce phénomène a été démontré déjà par Fr. Johnstrup (9). A l'époque de mes recherches sur la faune de mollusques, il y a trente ans, on avait connaissance déjà de quelques exemplaires de *Pleurotomaria niloticiformis* et *Cypraea bullaria* dont le test était, en apparence au moins, bien conservé. Ces coquilles étaient naturellement considérées comme des choses très rares, mais les conditions dans lesquelles elles avaient été trouvées étaient inconnues. Au cours d'une excursion avec des étudiants d'histoire naturelle je réussis cependant, en 1902, à trouver la région de la carrière d'où, selon toute probabilité, ces coquilles tiraient leur origine. Cette région constituait alors une grande saillie dans la partie orientale de la carrière. Cette région se voit à peu près au centre du deuxième plan de la grande photographie de la carrière de Faxe donnée par M. V. Milthers (11; pl. 31), et c'est justement cette partie de la photographie qui a été plus tard reproduite par M. K. Brünnich Nielsen (13; fig. 1) et que nous reproduisons ci-contre (fig. 1). Il y a quelques années cette région fut détachée de la paroi nord de la carrière, de manière à former ainsi une petite »colline« isolée. C'est ainsi qu'on la voit, sous la désignation »Ko«, dans un croquis publié en 1911 par M. K. Brünnich Nielsen (12; fig. 1), et reproduit ici (fig. 2). Les géologues lui ont conféré le nom de »Nez« (ou »Nez de Ravn«). L'extraction de chaux des dernières années l'a fait presque complètement disparaître. La roche de cette région est un calcaire coralliaire constitué essentiellement de petits fragments des espèces communes au calcaire de Faxe avec une matière intermédiaire très fine, crayeuse. Quelquefois on trouve pourtant dans cette masse incohérente des parties plus dures plus ou moins grandes. Justement à cause de l'état brecciolaire du calcaire les géologues n'y avaient pas antérieurement attaché grande attention. Plus tard il a été constaté cependant qu'il renferme une faune d'une richesse extraordinaire.

M. K. Brünnich Nielsen a donné un bref aperçu de la faune du »Nez« (13; p. 27—42). Il spécifie ici e.a. un certain nombre de genres de petits gastropodes et pélécypodes qui n'étaient pas connus auparavant du calcaire de Faxe. C'est qu'il avait découvert qu'il était possible, au moyen d'un lavage, de retirer du calcaire brecciolaire un grand nombre de formes minuscules, dont le test paraissait très bien conservé. Dans la plupart des cas la protoconque même est conservée, et l'ornementation, jusqu'à la plus délicate, est encore visible. Comme résultat de ses recherches M. le professeur Bøggild a cependant constaté que ce n'est qu'en apparence que le test est conservé; l'aragonite primordiale se trouve transformée en calcite granulée. Mais ce phénomène n'est d'aucune importance pour l'étude paléontologique. Une autre circonstance favorable à l'étude est due au fait que les tests ne sont ordinairement pas recouverts de l'incrustation de calcite qui peut se trouver sur les fossiles

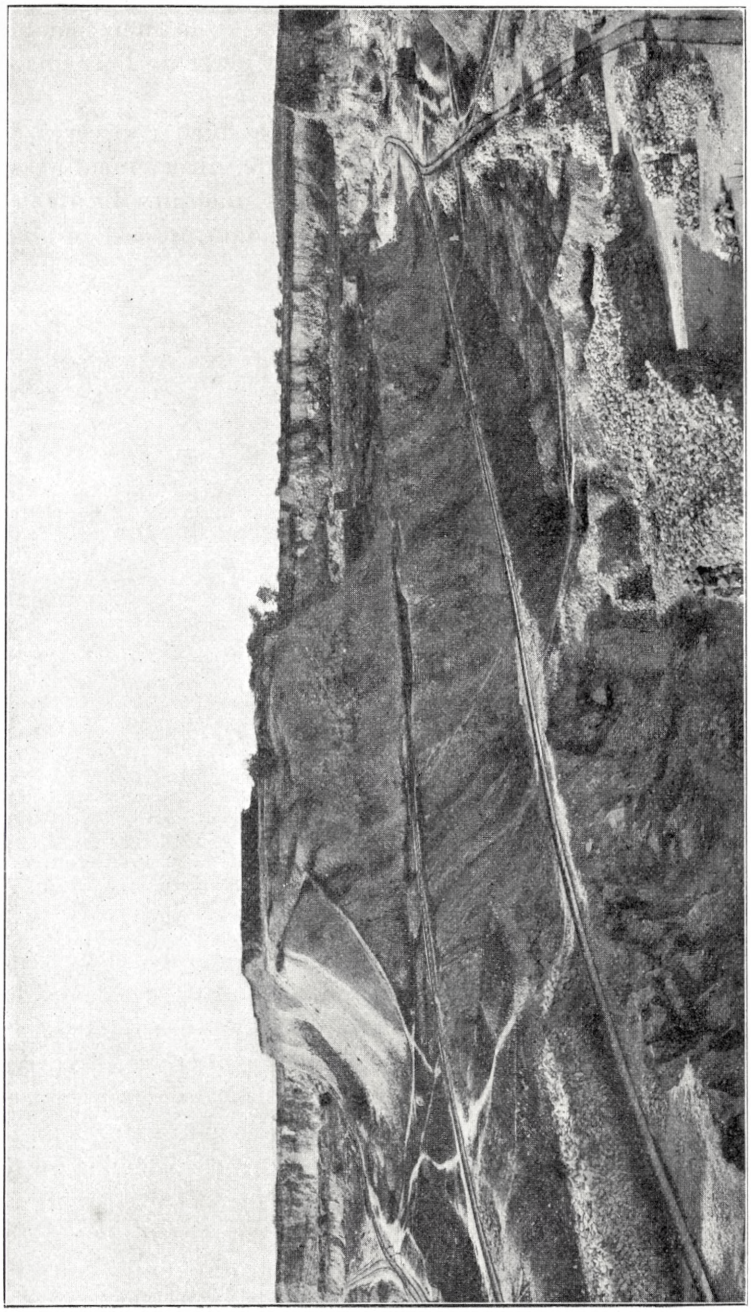

Fig. 1. Partie de la carrière de Faxe. Le »Nez« se voit au centre du deuxième plan. D'après V. Milthers.

provenant d'autres régions de la carrière. Les coquilles de *Pleurotomaria* et *Cypraea* mentionnées plus haut sont également transformées de la même manière. Comment cette transformation ait pu se faire sans amener la perte de l'ornementation souvent très délicate est un phénomène encore inexplicable.

Peu de temps après la découverte des fossiles bien conservés dans le »Nez« j'ai réussi à trouver, dans la paroi sud de la carrière, directement au sud du »Nez«, un calcaire brecciolaire du même type contenant quelques beaux fossiles, surtout d'*Isoarca*. Cette localité n'avait pas été exploitée pendant un certain nombre d'années,

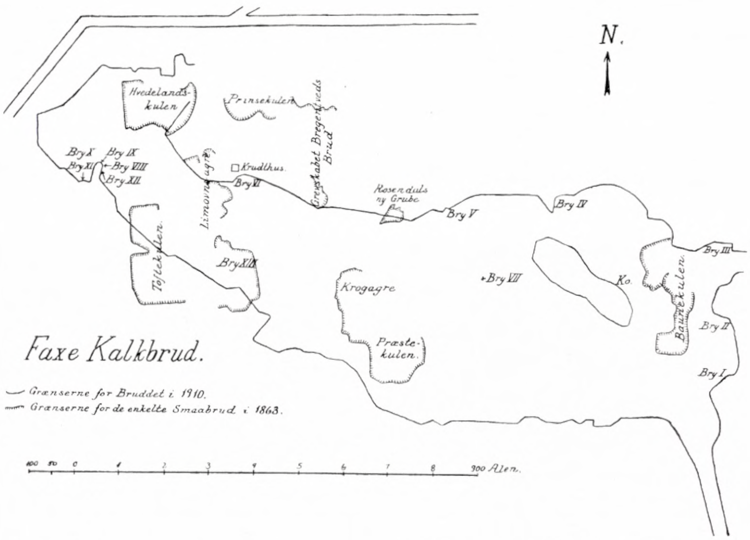

Fig. 2. Croquis de la carrière de Faxe, indiquant les limites en 1910 et les petites carrières isolées datant de 1863. (1 Alen = 1,25 m). Ko = Le »Nez«. D'après K. Brünnich Nielsen.

et la paroi escarpée ne tardait pas à être couverte d'éboulis et de végétation. Il y a quelque temps on a cependant repris l'exploitation ici, et le calcaire brecciolaire est maintenant accessible sur une grande étendue. M. A. Rosenkrantz a dernièrement fait une grande récolte ici et, comme on pouvait s'y attendre, il en résulte que l'on trouve également ici un grand nombre de petits gastropodes et pélécypodes à test en apparence bien conservé. Ces matériaux, qui n'ont été procurés qu'après la terminaison de mes études, n'ont pas encore été soumis à l'étude, mais un examen rapide de matériaux recueillis par moi, semble donner pour résultat qu'ils ne contiennent pas beaucoup de formes autres que celles qu'on connaît du »Nez«. — M. Rosenkrantz m'a encore informé du fait que, environ à mi-chemin entre la localité citée en dernier lieu et le »Nez«, il a trouvé une toute petite partie, aujourd'hui complètement enlevée, du même calcaire mou, à petits gastropodes et pélécypodes. Il semble donc que le calcaire coralliaire mou a constitué une région s'étendant du nord au sud à travers la carrière; jusqu'ici on ne l'a pas observé cependant dans la paroi nord. Il ne se continue probablement pas très profondément dans le sol attendu qu'il est inconnu de la partie la plus inférieure de la carrière. On ignore pourquoi l'on trouve un calcaire coralliaire relativement si peu transformé dans le »Nez« et les localités rapprochées. Le fait que les branches de corail ne se trouvent qu'en petits fragments est probablement dû à la compression du calcaire coralliaire, originairement d'une structure peu compacte.

Comme nous l'avons dit ci-dessus, la plupart des mollusques trouvés dans le »Nez« appartiennent à des espèces petites, mais en outre, on a trouvé ici les jeunes d'un nombre d'espèces plus grandes assez considérable, tandis que les adultes font presque complètement défaut. Il semble qu'une classification d'après le volume, due à des courants d'eau, ait eu lieu ici.

D'après M. le Dr. F. A. Schilder (16; p. 4, note 4) M. le Dr. H. Ødum a déclaré que le calcaire coralliaire mou constitue la partie la plus postérieure du calcaire de Faxe. On ignore ce qui sert d'appui à cette déclaration, aucune indication n'ayant été fournie à ce sujet. Les conditions de gisement ne sont guère de nature à fournir un point d'appui sous ce rapport, et en ce qui concerne la faune M. Brünnich Nielsen, dans la mention qu'il fait du »Nez«, a sans doute raison de dire qu'à tout prendre il ne semble pas y avoir de différence dans la faune du banc de corail, à n'importe quel endroit de la carrière qu'elle soit recueillie. On a naturellement ici fait abstraction de toutes les formes petites, dont la présence dans le »Nez« et l'absence ailleurs dans le Calcaire à Coralliaires est probablement due au fait que le calcaire est beaucoup moins transformé dans le »Nez« que dans les autres parties de la carrière.

B. Résultats des études.

On a fait remarquer plus haut que les coquilles du «Nez» sont assez bien conservées pour que, dans la plupart des cas, on puisse étudier non seulement l'ornementation mais encore la structure de la protoconque. Ceci est évidemment d'une grande importance pour la détermination. Si, néanmoins, la détermination du genre est quelque peu douteuse pour certaines espèces la cause en est que la partie autour de l'ouverture fait souvent défaut. Dans ces cas il est bien possible, à l'aide du diamètre du tour et de la marche des stries d'accroissement, de se faire une idée de la forme de l'ouverture, mais d'autres éléments d'identification importants, tels, p. ex., que la présence d'un bord d'ouverture épaissi et de dents à l'interieur du labre externe de même que la forme du canal, se dérobent à l'examen. L'incertitude en question ici se trouve peut-être encore augmentée par le fait que nous avons affaire ici à une faune d'une période caractérisée par une évolution rapide dans le domaine des mollusques et surtout de la classe des gastropodes, évolution aboutissant à la différentiation en une foule de genres nouveaux. Cette différentiation n'avait pas toujours atteint son terme à l'époque danienne, et il peut donc arriver qu'on se heurte à des formes dont le placement dans le système est plus ou moins douteux. Ainsi, il est possible, et même probable, qu'il y aura des corrections à apporter à mes déterminations de genre. Une connaissance plus ample des petites formes de mollusques du Sénonien sera sans doute d'une grande importance à cet égard.

Le nombre de pélécypodes et gastropodes de notre Danien a été aujourd'hui considérablement augmenté; le présent travail cite non moins de 137 espèces se rapportant à ces deux classes, contre 56 espèces connues jusqu'ici. Chose remarquable, le nombre d'espèces de gastropodes a été augmenté beaucoup plus fortement que le nombre d'espèces de pélécypodes; on avait connu jusqu'ici 29 pélécypodes et 27 gastropodes, tandis que les nombres respectifs sont actuellement de 39 et 98. Dans la classe des pélécypodes le nombre d'espèces nouvellement acquises s'élève donc seulement à 26 $^0/_0$, tandis que le pour-cent dans la classe des gastropodes monte jusqu'à 73. La cause principale de cette différence évidente est à chercher dans le fait que dans le calcaire tout particulier du »Nez« nous avons trouvé un dépôt où les formes à test aragonitique sont bien conservés, et ces formes jouent un plus grand rôle dans le domaine des gastropodes que dans celui des pélécypodes. Cette différence peut probablement en second lieu être attribuée au fait que l'évolution des *Heterodonta sinupalliata* ne commence son accroissement rapide qu'après la fin de l'époque danienne.

Un examen des pélécypodes trouvés dans le Calcaire de Faxe nous montre immédiatement que les *Anisomyaria* jouent le rôle principal; de ce groupe on a trouvé 12 genres différents comprenant 19 espèces, c'est à dire la moitié de toutes les espèces trouvées. En fait d'*Homomyaria* on rencontre surtout des *Taxodonta*, à savoir 12 espèces réparties en 7 genres. Des 8 espèces qui sont de reste, une seule (*Teredo* sp.) appartient au sous-ordre des *Desmodonta*, les autres aux *Heterodonta integripalliata*, tandis que les *Heterodonta sinupalliata* font complètement défaut.

Les 98 espèces de gastropodes appartiennent au total à l'ordre des *Prosobranchia*. Le nombre de beaucoup le plus important représente le sous-ordre des *Ctenobranchina*; à ce groupe se rapportent non moins de 40 genres avec 78 espèces. Du sous-ordre des *Aspidobranchina* on connaît 12 genres avec 17 espèces, de celui des *Cyclobranchina* 2 espèces douteuses de *Patella*, et de celui des *Heteropoda* une seule espèce, *Eoatlanta spiruloides*.

Comme nous l'avons fait remarquer déjà nous constatons dans le Calcaire de Faxe l'absence complète des *Heterodonta sinupalliata*, qui constituent le groupe le plus récent dans le domaine des pélécypodes et qui jouent un si grand rôle depuis la période tertiaire jusqu'au temps actuel. — Les 26 genres trouvés sont d'un âge relativement reculé; à l'exception d'un seul ils peuvent tous être rapportés au temps antérieur à l'époque danienne. L'unique exception est *Ciplyella*, qui n'est connue que du Danien et du Tuffeau de Ciply. La plupart des genres possèdent des espèces vivant aujourd'hui; il y en a certains, pourtant, qui s'éteignent avec la période crétacique, à savoir *Isoarca*, *Gervilleia* et *Stegoconcha*. Comme l'a démontré M. J. Böhm (2; p. 148) ce dernier genre peut être poursuivi jusqu'au Jurassique supérieur, et l'espèce trouvée dans notre Danien est le dernier représentant du genre. On peut faire remarquer encore que *Cardium Vogeli* appartient au sous-genre *Protocardia*, qui s'éteint à la fin de la période crétacique. Il ressort de ce qui précède que la faune des pélécypodes du Calcaire de Faxe a un aspect crétacique marqué. Nous verrons dans la suite qu'apparemment il n'en est pas ainsi dès qu'il s'agit de la faune des gastropodes.

Abstraction faite des genres qui ne sont pas sûrement déterminés et des deux genres nouveaux il se trouve que la majorité des genres de gastropodes (à savoir 26) peut être suivie jusqu'à la période crétacique ou à des périodes encore plus reculées. Il reste cependant un nombre considérable (à savoir 18), que l'on n'avait pas trouvés jusqu'ici dans des formations antérieures à celles de la période tertiaire. La faune acquiert par là, naturellement, à un certain degré un aspect tertiaire. Il en résulte que déjà à l'époque danienne il y a eu dans le domaine des gastropodes une évolution très active ayant pour résultat la différentiation en une quantité de genres nouveaux, dont la plupart arrivaient à jouer un grand rôle dans les temps suivants. Il y a certains genres, pourtant, qui montrent que nous avons affaire à une faune relativement ancienne. Ainsi, *Eucycloscala* et *Tylostoma* s'éteignent avec la période crétacique et ne sont pas connues du Tertiaire. Il est à remarquer encore ici qu'après une étude des Cypraeides du Danien de Danemark et de Scanie F. A. Schilder (16; p. 27) s'exprime ainsi: »Die Cypraeacea-Fauna des Danium spricht also eher für seine Zuteilung zur Kreide als zum Tertiär«.

Une comparaison avec la faune d'autres dépôts est rendue particulièrement difficile par le fait que non seulement les espèces de pélécypodes et gastropodes décrites du «Nez» mais aussi les espèces de notre Danien décrites antérieurement ont été trouvées, presque sans exception, seulement dans le Danien du Danemark et de la Scanie. Ceci peut évidemment faire naître quelque incertitude quant au placement du Danien. Il y a quelques années j'ai eu l'occasion de formuler ma manière de voir à cet égard, et comme mes nouvelles recherches n'ont rien changé à cette manière de voir je puis me borner ici à renvoyer au travail cité (15). Mais depuis lors une couple de travaux de É. Vincent ont été publiés, et il y a lieu d'en dire quelques mots, attendu que cet auteur s'occupe ici de la question du rapport entre notre Danien et certains dépôts de la Belgique. Dans le premier de ces travaux (17) Vincent rapporte qu'en creusant des puits de mines à Eysden dans la Campine (nord-est de la Belgique), à une profondeur de 236 à environ 255 m, on a trouvé des calcaires sous-jacents au Calcaire de Mons, qu'il rapporte au Tuffeau de Ciply. Dans ces calcaires on a trouvé une faune qui, outre des formes plus ou moins indéterminables, renferme un certain nombre d'espèces nouvelles de même que *Crania tuberculata* Nils. et *Ditrupa Schlotheimi* Rkz., deux espèces communes à la partie supérieure du Danien danois. Vincent fait encore ressortir que par ses études des pélécypodes du Tuffeau de Ciply il a trouvé un certain nombre d'autres espèces qui peuvent être plus ou moins sûrement identifiées à des espèces de notre Danien. Ces espèces sont: *Ciplyella*[1]) *pulchra* (Ravn), *Isocardia faxensis* Ldgrn., *Spondylus faxensis* Ldgrn.(?)[2]), *Gryphaea vesicularis* (Lamk.) (y compris *Ostrea hippopodium* Nils.), *Barbatia forchhammeri*

[1]) Vincent applique ici le nom de *Cipliacella* à ce genre.

[2]) Les espèces citées par Vincent sous réserve, sont marquées: (?).

(Ldgrn.)(?) et *B. tenuidentata* Hng.(?)[1]), *Lima holzapfeli* Hng., et enfin *Modiola cottae* Röm.[2]). S'appuyant sur la présence de ces espèces, qui sont supposées communes au Danien danois et au Tuffeau de Ciply, Vincent s'exprime ainsi (l. c., p. 14): »Aussi, dans l'état actuel de nos connaissances, sommes-nous bien plus porté à envisager les couches de Ciply non plus comme un Danien supérieur, inconnu au Danemark, mais simplement comme l'équivalent, si pas du Danien danois en entier, du moins de sa partie supérieure«. Dans un travail postérieur (posthume) (18) Vincent cite une partie de ces espèces et encore deux autres espèces, qui se trouvent dans notre Danien, à savoir *Ostrea canaliculata* Sow. et *Lima densestriata* Hng., comme représentées dans le Tuffeau de Ciply. Ce sont probablement les vues émises par Vincent qui ont fait que, contrairement à ce qui avait eu lieu antérieurement, dans la dernière »Légende générale de la Carte géologique détaillée de la Belgique«[3]) on a placé le Montien dans le système crétacique.

Il y a évidemment certains faits qui militent en faveur du point de vue émis ici par Vincent; je dois cependant faire ressortir que dans la faune du Tuffeau de Ciply une foule de genres sont représentés qui ne sont pas connus de notre Danien, et que bon nombre de ces formes (surtout dans le domaine des familles de Lucinides et des Cardiides) impriment un certain aspect tertiaire à cette faune, tandis que, d'autre part, les genres éminemment anciens de *Gervilleia, Stegoconcha* et *Eucycloscala*, de même que certaines formes anciennes de *Cypraea*, y font défaut. Que, comme le pense Vincent, la différence assez considérable qui existe entre les faunes de notre Danien et du Tuffeau de Ciply, soit due uniquement à une différence de faciès, me paraît quelque peu douteux. On arrivera probablement à constater que la différence est due aussi à une différence d'âge, le Tuffeau de Ciply étant probablement un peu postérieur à notre Danien supérieur. En ce qui concerne l'âge, ce sont probablement les dépôts d'Eysden étudiés par Vincent, qui se trouvent le plus rapprochés de notre Danien; la présence de deux espèces daniennes typiques telles que *Crania tuberculata* et *Ditrupa schlotheimi* sont un indice dans ce sens. Il est à espérer qu'on réussira à produire de nouveaux et meilleurs matériaux de ces dépôts. Par ce moyen on serait sans doute à même de faire avancer d'un grand pas la solution définitive du problème du placement du Danien danois. Une étude renouvelée des faunes respectivement des dépôts crétaciques belges les plus supérieurs et du Calcaire de Vigny et d'autres dépôts du même âge de la part de collègues belges et français contribuerait grandement aussi au même but.

Dans la partie descriptive qui va suivre je me suis servi essentiellement de la systématique de la dernière édition de Zittel: »Grundzüge der Paläontologie«; pour ce qui est de la délimitation des genres, je l'ai fait correspondre autant que possible aux travaux de Cossmann, notamment à son grand ouvrage, malheureusement inachevé: Essais de Paléoconchologie comparée.

[1]) Ces deux espèces sont supposées synonymes de *B. tabulata* Nyst. mss.

[2]) Cette espèce est dite être synonyme de *M. ciplyensis* Ryckh.

[3]) Ann. des Mines de Belgique, t. XXX, 1e liv. Bruxelles 1929.

B. Pélécypodes.

Famille: **Nuculidae.**

Genre: Leda Schum. (1817).

1. **Leda** sp. (I).

Quelques petites coquilles, plus ou moins défectueuses, doivent être référées à une espèce quelconque du genre *Leda*, mais les matériaux présents ne suffisent pas pour la détermination de l'espèce. Parmi les espèces décrites du paléocène de l'usine à gaz, c'est la *L. symmetrica* v. Koen. qui a la plus grande ressemblance avec l'espèce présente, la lunule et le corselet faisant défaut dans les deux espèces.

Le »Nez«: 4 individus à deux valves.

2. **Leda** sp. (II).

Un single individu (à deux valves) a le galbe un peu plus oblique que celui de l'espèce précédente et sa lunule est distinctement limitée. Ainsi il appartient probablement à une espèce différente.

Le »Nez«: 1 individu à deux valves.

Famille: **Arcidae.**

Genre: Macrodon Lycett (1845).

3. **Macrodon macrodon** (Ldgrn.).

(Voir 1902. Ravn, Mollusk. i Danmarks Kridtafl. I. p. 121; pl. III, fig. 1).

On n'a pas trouvé de matériaux nouveaux de cette espèce.

Calcaire à Coralliaires: Rare.

4. **Macrodon faxensis** n. sp.

Pl. I, fig. 1 a—c.

Très petite coquille, rhomboïdale, assez comprimée, un peu plus étroite du côté antérieur qu'en arrière. Bord antérieur arrondi, passant lentement au bord ventral, formant un angle d'environ 120° avec le bord dorsal. Bord postérieur rectiligne en bas, mais courbé en avant vers le bord dorsal, formant avec celui-ci un angle d'environ 140°. Bord ventral peu convexe, formant un angle aigu avec le bord postérieur. Crochet petit, pointu, faiblement courbé, placé bien en avant du milieu. Aire ligamentaire très restreinte. Lame cardinale assez étroite, portant deux petites dents obliques en avant, et deux ou trois dents horizontales en arrière du crochet, la supérieure des dernières étant très longue. Bords faiblement crénelés. — Surface extérieure munie d'une carène descendant obliquement du crochet vers l'angle inférieur et limitant le côté postérieur. L'ornementation formée de côtes rayonnantes, très fines sur le milieu de la valve et un peu plus grosses sur les régions latérales; en outre des sillons concentriques indistincts.

Longueur, 3,9 mill.; hauteur, 2 mill.; épaisseur (d'une single valve), 0,7 mill.

Il semble résulter du galbe de la valve, de la position de la carène et de la rectitude du bord dorsal, que notre espèce ne puisse pas représenter un jeune individu de l'espèce précédente.

Le »Nez«: 1 valve.

Genre: Cucullaea Lamk. (1801).

5. **Cucullaea crenulata** (Ldgrn.).

(Voir 1902. Ravn, Mollusk. i Danmarks Kridtafl. I. p. 123).

Calcaires à Coralliaires et à Bryozoaires: l'espèce est trouvée assez fréquemment dans le »Hvedeland« (partie nord de la carrière).

Genre: Barbatia Gray (1840).

A ce genre Hennig a rapporté deux espèces trouvées dans le Danien à Annetorp et à Faxe dont l'une, *B. forchhammeri*, avait été décrite déjà par Lundgren, tandis que l'autre, *B. tenuidentata*, était nouvelle. A celles-ci s'ajoutent maintenant une couple d'éspèces nouvelles, pas décrites antérieurement. Malheureusement les types de Hennig ont disparu il y a longtemps, en sorte que, comme on le verra plus tard, on ne peut pas établir tout à fait distinctement le rapport entre ces 4 espèces.

6. **Barbatia (Acar) forchhammeri** (Ldgrn.).

(Voir 1902. Ravn, Mollusk. i Danmarks Kridtafl. I. p. 121; pl. III, fig. 10).

Dans ma description citée plus haut j'ai rendu attentif au fait que l'ornementation des individus de Faxe semble un peu différente de celle des individus suédois, attendu qu'elle ressemble plutôt à l'ornementation de *B. tenuidentata*. Par contre, la description et la figuration de l'ornementation faites par Hennig correspondent bien à *B. faxensis* n. sp. décrite plus bas; il se pourrait donc que Hennig aura confondu deux espèces. Ceci ne peut cependant pas se constater avec pleine certitude attendu que, comme déjà dit, les types de Hennig ont disparu.

L'ornementation est pareille à celle de *B. lamellosa* (Desh.) var. *tabulata* Nyst., mais le bord antérieur de la coquille est loin d'être aussi atténué que chez cette forme.

Calcaire à Coralliaires et à Bryozoaires: assez abondante.

7. **Barbatia (Plagiarca) faxensis** n. sp.

Pl. I, fig. 2 a—b et 5.

Assez petite coquille, comprimée, quadrangulaire, arrondie. Crochet pointu, fortement prosogyre. Bords latéraux arrondis, passant lentement au bord ventral; celui-ci à peu près parallèle au bord dorsal et parfois faiblement sinueux au milieu. Aire ligamentaire très étroite, longue et distinctement limitée en avant. Charnière interrompue, portant un assez grand nombre de dents obliques (environ 6 en avant, 13 en arrière), celles du milieu étant un peu plus petites que les autres. Bords non crénelés. Surface extérieure munie d'une carène très émoussée, partant du crochet et descendant à l'angle postérieur. L'ornementation formée de côtes rayonnantes en grand nombre, croisées de sillons assez serrés, concentriques, produisant des petits tubercules assez arrondis, rangés en séries radiales et concentriques; l'ornementation plus grosse vers les bords latéraux.

Longueur, 8,8 mill.; hauteur, 4,4 mill.; épaisseur (des deux valves), 3,5 mill.

Comme mentionné ci-dessus, l'ornementation de cette espèce s'accorde avec la description qu'a donnée Hennig de l'ornementation de la *B. forchhammeri*, mais la coquille ne possède pas la carène aiguë, et son bord postérieur est plus arrondi.

La *B. faxensis* se distingue de la *B. proxima* Dufour par sa longueur plus grande et par ses bords latéraux plus arrondis. Notre espèce se rapproche aussi des petits individus de la *B. rutoti* Cossm. du Calcaire de Mons, mais elle a le bord ventral moins sinueux et l'ornementation concentrique plus évidente. De l'*Arca montensis* Cossm. elle se distingue par son galbe moins oblique et plus rectangulaire.

Le »Nez«: 2 individus à deux valves et 4 singles valves. — En outre on a trouvé un individu (à deux valves) dans le conglomérat à *Crania tuberculata* dans le »Hvedeland«, Faxe.

8. **Barbatia (Arcopsis[1]) brünnichi** n. sp.

Pl. I, fig. 3 a—b et 4 a—b.

Petite coquille, rhomboïdale, arrondie, assez comprimée. Bord antérieur subsémicirculaire, formant un angle obtus avec le bord cardinal; bord ventral faiblement courbé, passant par un angle fort arrondi au bord postérieur; celui-ci à peu près rectiligne, formant un angle très obtus avec le bord cardinal. Crochet pointu, très faiblement prosogyre. Aire ligamentaire distinctement limitée, proportionnellement haute, excavée, portant un petit nombre de stries horizontales. Sous le crochet une

[1] Cossmann a rapporté en 1887 (Cat. illustré. II. p. 142) à une nouvelle section du genre *Arca* toutes les espèces qui portent sous le crochet une petite fossette triangulaire, et il a nommé cette section *Fossularca*. Cependant v. Koenen a donné en 1885 (Paleocäne Fauna von Kopenhagen. p. 86) à ces espèces le nom d'*Arcopsis*, dénomination qui, comme l'a montré É. Vincent, doit avoir la priorité.

petite fossette triangulaire. Lame cardinale étroite; charnière interrompue sous le crochet, composée d'environ 8 dents obliques en avant et environ 11 en arrière, celles du milieu plus petites que les autres. Surface extérieure munie d'une carène comme celle de l'espèce précédente et couverte de côtes fines, concentriques, serrées, croisées de sillons rayonnants un peu plus fins; côtes des régions latérales un peu plus grosses que celles du milieu. Bords des valves lisses.

Longueur, 5 mill.; hauteur, 3,1 mill.; épaisseur (des deux valves), 2,4 mill.

L'espèce se rapproche de l'*Arca limopsis* v. Koen. du paléocène de Copenhague, mais elle a la forme ordinairement plus prolongée et moins bombée. L'*Arca quadrilatera* Desh. a le galbe beaucoup plus rectangulaire. L'*Arca capillacea* Desh. est plus prolongée du côté postérieur. Notre espèce a la plus grande ressemblance avec les figures de l'*A. cossmanni* de Laub., données par Cossmann, mais les individus de cette espèce, que j'ai vus à La Sorbonne, ont la forme beaucoup plus triangulaire.

Le »Nez«: 22 individus (à deux valves) et 35 singles valves.

9. **Barbatia (Arcopsis?) curta** n. sp.

Pl. I, fig. 9 a—b.

Petite coquille, très courte, obliquement quadrangulaire, assez bombée. Bord cardinal très court, formant un angle droit et un peu arrondi avec le bord antérieur faiblement courbé; bord postérieur en haut rectiligne, formant un angle obtus avec le bord cardinal, en bas réuni au bord ventral faiblement courbé, par une courbe courte. Crochet pointu, assez prosogyre. Aire ligamentaire distinctement limitée, très courte, excavée, proportionnellement haute, munie d'une petite fossette triangulaire sous le crochet. (Charnière non visible). Surface extérieure munie d'une carène comme celle de l'espèce précédente. Ornementation composée de côtes nombreuses, fines, rayonnantes, croisées de sillons concentriques d'une grosseur variable. Bords des valves probablement lisses.

Longueur, 3,6 mill.; hauteur, 2,8 mill.; épaisseur (des deux valves), 2,3 mill.

Cette espèce se distingue par sa forme très courte et bombée. La charnière des individus trouvés étant invisible, la position systématique de l'espèce est assez douteuse.

Le »Nez«: 3 individus à deux valves.

Genre: Isoarca Münst. (1842).

10. **Isoarca obliquedentata** (M. U. H.), (Ldgrn.).

(Voir 1902. Ravn, Mollusk. i Danmarks Kridtafl. I. p. 124; pl. IV, fig. 6).

Calcaires à Coralliaires et à Bryozoaires: abondante.

Genre: Pectunculus Lamk. (1799).

11. **Pectunculus sublenticularis** Ravn.

(Voir 1902. Ravn, Mollusk. i Danmarks Kridtafl. I. p. 125; pl. IV, fig. 7—9).

Calcaires à Coralliaires et à Bryozoaires: assez abondant.

Genre: Limopsis Sassi (1827).

12. **Limopsis obesa** n. sp.

Pl. I, fig. 6 a—b.

? 1902. *Limopsis Höninghausi* (J. Müll.); Ravn, Mollusk. i Danmarks Kridtafl. I. p. 125.

Assez petite coquille, ovale, oblique, très bombée, un peu plus haute que longue. Bord antérieur faiblement courbé; son angle avec le bord cardinal environ 120°. Bord postérieur un peu plus courbé, formant un angle d'environ 140° avec le bord cardinal. Bord ventral très fortement courbé. Crochet placé un peu en avant du milieu du bord cardinal. Aire ligamentaire courte, basse, munie, sous le crochet, d'une fossette large, triangulaire. Surface extérieure couverte de côtes approchées, concentriques, d'une grosseur assez variable, mais toujours très fines. Charnière non visible.

Longueur, 5,2 mill.; hauteur, 5,8 mill.; épaisseur (des deux valves), 4 mill.

Il est indubitable que l'espèce décrite ici ne peut pas être identique à *L. höninghausi*. Ainsi p. ex. elle est beaucoup moins quadrangulaire et son crochet est beaucoup plus rapproché du milieu. Il est difficile de dire de façon absolue si les moules de Faxe, que j'ai antérieurement (l. c.) rapportés à *L. höninghausi*, pourront être référés à la nouvelle espèce, attendu qu'une comparaison directe de coquille et moule interne est toujours une affaire délicate; il me semble pourtant qu'à tout prendre il y a une telle correspondance entre les moules cités et le nouvel exemplaire à test conservé qu'ils peuvent très bien être de la même espèce. Si cela est le cas aussi pour les moules du Danien de la Scanie décrits par Hennig (Faunan i Skånes Yngre krita. II. p. 21; pl. 2, fig. 27—28) n'est pas facile à dire de façon décisive, attendu que les exemplaires originaux de Hennig ont probablement disparu. — *L. obesa* est très voisine de *L. lentiformis* Desh. et *L. altera* (Lamk.), mais ces deux dernières espèces sont plus aplaties, et la première d'entr'elles est aussi moins oblique. Chez *L. minuscula* Cossm. le bord supérieur est notablement plus long en arrière, formant ainsi un angle moins obtus avec le bord postérieur.

Le »Nez«: 1 individu à deux valves.

Famille: **Crassatellidae.**

Genre: Crassatella Lamk. (1801).

13. **Crassatella faxensis** Ravn.

(Voir 1902. Ravn, Mollusk. i Danmarks Kridtafl. I. p. 128; pl. IV, fig. 16—20).

Calcaires à Coralliaires et à Bryozoaires: assez abondante.

Famille: **Isocardiidae.**

14. **Isocardia faxensis** (M. U. H.), Ldgrn.

(Voir 1902. Ravn, Mollusk. i Danmarks Kridtafl. I. p. 131; pl. IV, fig. 22).

Calcaires à Coralliaires et à Bryozoaires: abondante.

Famille: **Chamidae.**

Genre: Ciplyella É. Vinc. (1930).

15. **Ciplyella pulchra** (Ravn).

1902. *Chama pulchra* (M. U. H.), Ravn, Mollusk. i Danmarks Kridtafl. I. p. 127; pl. IV, fig. 12—15.
1928. *Cipliacella pulchra* (Ravn); É. Vincent, Couches mont. d'Eysden. p. 565.
1930. *Ciplyella pulchra* (Ravn); É. Vincent, Moll. mont. p. 111; pl. VI, fig. 12.

De la *Chama pulchra*, que j'ai décrite, il y a trente ans, É. Vincent a fait le type d'un genre nouveau, qu'il a nommé d'abord *Cipliacella* et plus tard *Ciplyella*. Dans la diagnose danoise j'ai fait mention d'une rainure creusée, qui s'étend, sur les moules, le long du côté postérieur du crochet jusqu'au côté intérieur de l'empreinte musculaire postérieure, et qui est due à une crête myophore de la coquille. Vincent attache tant d'importance à cette crête qu'il retire notre espèce des chames pour l'ériger au rang de genre. Ce genre n'est connu que par l'espèce ici mentionnée, qu'on a recueillie à Faxe et dans le Poudingue de Ciply.

Vincent écrit qu'à mon avis la coquille se fixait par la valve gauche. Cela n'est pas complètement juste. J'ai apprécié les irrégularités qui se remarquent souvent sur la région antérieure des moules comme une indication de l'attachement (comme chez les *Spondylus*), et, comme ces irrégularités se trouvent le plus souvent sur la valve gauche, j'ai dit que c'était le plus souvent cette valve par laquelle se fixait la coquille.

Calcaire à Coralliaires: assez rare. Dans le »Nez« on n'a pas trouvé cette espèce.

Famille: **Cardiidae.**

Genre: Cardium Linné (1758).

16. **Cardium schlotheimi** Ldgrn.

(Voir 1902. Ravn, Mollusk. i Danmarks Kridtafl. p. 130).

Calcaires à Coralliaires et à Bryozoaires: assez rare.

17. **Cardium (Protocardia) Vogeli** Hng.

(Voir 1902. Ravn, Mollusk. i Danmarks Kridtafl. I. p. 130; pl. IV, fig. 25—26).

Cette espèce est rapprochée par Hennig du *Nemocardium*, mais son ornementation indique plutôt le sous-genre *Protocardia*.

Calcaires à Coralliaires et à Bryozoaires: assez abondant.

Famille: **Cyprinidae.**

Genre: Cypricardia LAMK. (1819).

18. **Cypricardia**? sp.

Un petit nombre de coquilles du Calcaire à Coralliaires du »Nez« sont probablement à rapporter au genre *Cypricardia* dans l'étendue que DESHAYES lui a donnée. Elles ont toutes la plus grande part des deux valves conservée. Elles ont le galbe obliquement quadrangulaire, et elles sont munies d'une carène assez tranchante au bord postérieur. Surface lisse. La charnière étant invisible le genre ne peut être déterminé de façon sûre.

Le »Nez«: 3 individus.

Genre: Veniella STOLICZKA (1870).

19. **Veniella** sp.

(Voir 1902. RAVN, Mollusk. i Danmarks Kridtafl. I. p. 132).

Calcaire à Coralliaires: rare.

Famille: **Pholadidae.**

Genre: Teredo LINNÉ (1757).

20. **Teredo** sp.

(Voir 1902. RAVN, Mollusk. i Danmarks Kridtafl. I. p. 134).

Calcaire à Coralliaires: très rare.

Famille: **Pinnidae.**

Genre: Stegoconcha JOH. BÖHM (1907).

21. **Stegoconcha faxensis** (RAVN).

1902. *Avicula faxensis* RAVN, Mollusk. i Danmarks Kridtafl. I. p. 81; pl. I, fig. 4—5.

M. J. BÖHM a fourni la preuve que cette espèce est le dernier membre d'une chaîne de formes qui peuvent se poursuivre jusqu'au Jurassique supérieur, et dont le membre le plus connu est »*Cardium*« *Neptuni* GOLDF.[1]). M. BÖHM réfère ces formes aux Pinnides et il les comprend dans un genre nouveau, qu'il a dénommé *Stegoconcha*.

Calcaires à Coralliaires et à Bryozoaires: 3 individus.

[1]) Voir: Zeitschrift d. deutsch. geol. Gesell. Vol. 59. Monatsberichte. p. 148. M. BÖHM commet ici une erreur de plume en appelant l'espèce *Avicula baltica* RAVN.

Genre: Pinna Linné (1758).

22. **Pinna** sp.

(Voir 1902. Ravn, Mollusk. i Danmarks Kridtafl. I. p. 104).

Calcaire à Coralliaires: 3 individus.

Famille: **Pernidae.**

Genre: Gervilleia Defr. (1820).

23. **Gervilleia** sp.

(Voir 1902. Ravn, Mollusk. i Danmarks Kridtafl. I. p. 102).

Calcaires à Coralliaires et à Bryozoaires: très rare.

Famille: **Limidae.**

Genre: Lima Brug. (1792).

24. **Lima (Ctenoides) holzapfeli** Hng.

(Voir 1902. Ravn, Mollusk. i Danmarks Kridtafl. I. p. 100; pl. II, fig. 15).

Calcaires à Coralliaires et à Bryozoaires: assez abondante.

25. **Lima (Limatula) semisulcata** (Nilss.).

(Voir 1902. Ravn, Mollusk. i Danmarks Kridtafl. I. p. 96; pl. II, fig. 10).

Calcaire à Bryozoaires: très rare.

26. **Lima (Mantellum) densestriata** Hng.

(Voir 1902. Ravn, Mollusk. i Danmarks Kridtafl. I. p. 98).

Calcaire à Bryozoaires: rare.

Famille: **Pectinidae.**

Genre: Chlamys Bolten (1798).

Chose curieuse, les coquilles de Pectinides sont assez rares dans le Calcaire de Faxe, et on n'en connaît que les coquilles de trois petites espèces. Attendu qu'on n'a trouvé qu'un seul individu à deux valves, la délimitation des espèces n'a pas encore pu être fixée avec certitude.

27. **Chlamys monotiformis** (Hng.)

1899. *Pecten monotiformis* Hennig, Faunan i Skånes yngre krita. II. p. 11; pl. 1, fig. 7—8.
1902. — — — ; Ravn, Mollusk. i Danmarks Kridtafl. I. p. 87.
1923. — *(Chlamys) monotiformis* Hng.; Jessen og Ødum, Senon og Danien ved Voxlev. p. 35.
1925. — *monotiformis* Hng.; Ravn, Placement géol. du Danien. p. 35.
1926. — *(Camptonectes) monotiformis* Hng.; Ødum, Daniet i Jyll. og paa Fyn. p. 178; pl. 2, fig. 6.

Cette espèce est représentée dans le Calcaire à Bryozoaires aussi bien que dans le Calcaire à Coralliaires par un nombre de coquilles plus ou moins intactes, coquilles dont l'ornementation est, en partie, extrêmement bien conservée. Ces matériaux donnent lieu aux remarques suivantes.

Valve droite aplatie, »monotiforme«. Bord cardinal infléchi. Oreillette antérieure probablement arrondie, non acutangulée comme dans la figure donnée par Hennig, munie d'environ 3 côtes rayonnantes, un peu granuleuses, séparée du reste de la valve par une région triangulaire, approfondie; bord antérieur de la valve distinctement concave sous l'oreillette (ainsi non conforme à la figure donnée par Hennig). Oreillette postérieure un peu moins obtusangle que la figure de Hennig ne l'indique. Surface extérieure couverte seulement de plis très aplatis, concentriques, parfois assez irréguliers, séparés d'intervalles assez équidistants; plis parfois plus développés sur la région centrale (près du cochet) que sur les bords. Surface de quelques valves, trouvées dans le calcaire à Bryozoaires, apparemment lisse, subsoyeuse, propriété peut-être due à l'incrustation intense.

Valve gauche aplatie comme la valve droite. Surface ornée de lamelles concentriques, distinctes, croisées de stries rayonnantes, plus ou moins visibles.

Calcaires à Coralliaires et à Bryozoaires: un assez grand nombre d'individus.

Cette espèce est très voisine de *Pecten sericeus* Grönw[1]). Les deux espèces se ressemblent tellement qu'il faut avoir sous la main des exemplaires très bien conservés pour pouvoir les distinguer. Les coquilles trouvées dans notre Danien étant souvent recouvertes d'une croûte de calcite la difficulté à les distinguer se trouve encore augmentée, et il n'y a donc rien d'étonnant à ce qu'on a quelquefois commis des erreurs ici. Pour arriver à bien élucider le rapport entre les deux espèces j'ai soumis à un examen détaillé tous les matériaux des différentes localités daniennes et paléocènes qui se trouvent au Musée, ce qui m'a amené au résultat suivant:

Les deux espèces semblent être tout à fait pareilles en ce qui concerne le galbe. Grönwall écrit que *Chl. monotiformis* est plus grand et plus aplati que *Chl. sericeus*, mais il n'en est pas ainsi dans tous les cas. Comme remarqué par Hennig ce n'est, chez *Chl. monotiformis*, que la région du crochet qui est bombée; les coquilles relativement grandes sont donc proportionnellement aplaties; les relativement petites (non adultes), par contre, sont proportionnellement plus bombées; quant au degré de convexité ces petites coquilles correspondent bien à *Chl. sericeus*, qui est presque toujours représenté par de petits individus. Chez les deux espèces le bord antérieur, est légèrement concave sous l'oreillette antérieure.

[1]) Grönwall, Karl A. og Harder, Poul: Paleocæn ved Rugaard i Jydland og dets Fauna. p. 28; pl. 1, fig. 7 à 10. — Danmarks geolog. Undersøgelse. II. R. Nr. 18. Kjøbenhavn 1907.

La valve droite est à peu près pareille dans les deux espèces. Ainsi, l'oreillette antérieure est un peu arrondie, surtout inférieurement, et elle n'est pas aussi rectangulaire que Hennig l'a indiqué pour *Chl. monotiformis*; elle est toujours munie de 3 à 4 costules rayonnantes granuleuses. La forme et la délimitation de l'oreillette postérieure semblent également toujours pareilles. Par contre, on voit ordinairement chez *Chl. m.*, surtout près du crochet, des plis concentriques, un peu irréguliers, que je n'ai pu sûrement observer chez aucun exemplaire de *Chl. s.*

La valve gauche dénote une plus grande différence. Ainsi, l'oreillette antérieure présente chez *Chl. m.* une dépression étroite, triangulaire le long du bord supérieur et, là-dessous, 4 à 5 côtes rayonnantes granulées, tandis que, chez *Chl. s.*, elle est lisse, exception faite des fossettes. De plus, l'oreillette antérieure est, chez cette dernière espèce, assez déjetée, tandis qu'elle est plus plane chez l'autre espèce. Lorsqu'il n'y a pas trop d'incrustation on observe chez les deux espèces les côtes ou lamelles concentriques, chez *Chl. s.* beaucoup plus serrées, toutefois, que chez *Chl. m.* Dans les cas où la surface est bien conservée on observe, chez la dernière espèce, des côtes rayonnantes fines, un peu irrégulières, prenant naissance au crochet et se poursuivant à peu près 2 mm vers le bas; à l'intersection des côtes concentriques se forme un petit nœud; quelquefois les traces de ces côtes rayonnantes se retrouvent plus bas, sur le bord inférieur des côtes concentriques; aux emplacements des côtes rayonnantes le bord se retrousse un peu, et il devient ainsi faiblement onduleux; sur les coquilles assez fortement incrustées ces petits retroussements peuvent adopter la forme de petites épines pliées en arrière. Je n'ai jamais vu cette ornementation radiaire chez *Chl. s.*

L'aperçu donné ci-dessous de l'extension des deux espèces ne comprend pas les trouvailles faites dans des lambeaux détachés ou dans des blocs erratiques.

Chlamys monotiformis (Hng.):

Ile de Saltholm: 1 valve droite et 1 valve gauche.
»Larsens Plads« (port de Copenhague): 1 valve droite, dans du Calcaire de Saltholm.
?Port sud de Copenhague: 4 coquilles, mal conservées, dans du sable calcaire.
?Thorslunde (Séeland oriental): 1 valve droite, dans du Calcaire à Bryozoaires.
?Thune (Séeland oriental): 1 valve droite, dans du Calcaire de Saltholm.
Faxe: un certain nombre de coquilles plus ou moins grandes, dans des Calcaires à Coralliaires et à Bryozoaires.
Stevns Klint (falaise de S.): 1 valve gauche, Calcaire à Bryozoaires.
Bulbjerg (Nord-ouest du Jutland); Calcaire à Bryozoaires: 1 valve droite.
Annetorp (Scanie): 4 coquilles.
?Klagshamn (Scanie): 2 valves droites.

Chlamys sericeus (Grönw.):

Kjøbenhavns Vestre Gasværk (usine à gaz, à Copenhague): 2 coquilles.
?Port sud de Copenhague; conglomérat de fond du paléocène: 1 valve droite.

Vodroffgaard (Copenhague); marne grise: 4 coquilles, très voisines, sous certains rapports, de *Chl. m.*
Lellinge (Séeland orientale); grès vert: abondante.
Kerteminde (Fionie); marne: quelques coquilles.
Rugaard (Jutland oriental): abondante; les coquilles appartiennent au Service de la carte géologique de Danemark.

L'extension étant ainsi établie *Chl. monotiformis* est à considérer comme une espèce danienne, tandis que *Chl. sericeus* se rapporte au paléocène. Les deux espèces sont si voisines l'une de l'autre que la dernière nommée peut être considérée, de bon droit, comme évoluée de la première.

28. **Chlamys cf. tesselatus** (Hng.).

1899. *Pecten tesselatus* Hennig, Faunan i Skånes yngre krita. II. p. 10; pl. 1, fig. 5—6.
1902. — — — ; Ravn, Mollusk. i Danmarks Kridtafl. I. p. 87.
1926. — *(Chlamys) tesselatus* Hng.; Ødum, Daniet i Jyll. og paa Fyn. p. 180; pl. 2, fig. 5.

Hennig indique que cette espèce est représentée à Faxe, et moi aussi j'ai auparavant — non sans scrupule — rapporté une couple de valves gauches à cette espèce, surtout parce que leur oreillette postérieure est très grande. Les matériaux de *Chl. monotiformis* actuellement en présence sont munis, cependant, d'oreillettes pareilles; ces coquilles seront par conséquent à rapporter à cette espèce.

On a trouvé maintenant un exemplaire fragmentaire de *Chl. tesselatus*, à double valve. L'oreillette antérieure de la valve gauche est à peu près rectangulaire, et la surface est munie d'étroites côtes concentriques et rayonnantes; ces dernières font défaut tout près du crochet, où l'ornementation concentrique est également très peu développée, en sorte qu'ici la coquille est presque lisse; du côté du bord ventral l'ornementation se fait plus marquée.

La plus grande part de la valve droite est conservée. L'oreillette antérieure semble rectangulaire, assez petite, et elle a été munie de côtes rayonnantes proportionnellement fortes; l'oreillette postérieure un peu obtuse. La surface paraît lisse, mais sous la loupe on voit des côtes concentriques extrèmement fines et très serrées, grossissant un peu du côté du bord ventral.

Longueur, 3,2 mm; hauteur, env. 3,5 mm; diamètre (des deux valves), 0,8 mm.

Le »Nez«: 1 individu à deux valves.

L'individu décrit ici s'éloigne du type de *Chl. tesselatus* en tant qu'il est presque lisse immédiatement au-dessous du crochet et, surtout, qu'il y a absence totale de traces d'une ornementation rayonnante sur la valve droite. Ceci s'explique peut-être par le fait que nous avons affaire à un jeune individu. Toutefois il reste douteux s'il faille le rapporter à l'espèce indiquée.

A en juger de la forme de la coquille et des oreillettes on serait porté à référer cette espèce au genre *Amussium* Klein, mais les côtes rayonnantes de la face intérieure caractérisant ce genre lui font défaut.

29. **Chlamys (Syncyclonema?) hennigi** n. sp.

Pl. I, fig. 7—8.

Un petit nombre de coquilles d'un très petit *Chlamys* doit être rapporté à une nouvelle espèce.

Coquille assez aplatie, un peu plus haute que longue. L'angle des bords au crochet environ 90°. Crochet très pointu.

Valve droite. Oreillettes distinctement délimitées; l'antérieure proportionnellement bien développée; son angle extérieur subrectangulaire; sinus du byssus profond; surface de l'oreillette couverte de côtes nombreuses, concentriques, régulières; au-dessus du bord inférieur de l'oreillette un sillon profond s'étendant du crochet jusqu'au milieu de l'oreillette. Oreillette postérieure courte, obtuse. Surface extérieure de la valve ornée de stries d'accroissement extrèmement fines.

Valve gauche. Oreillettes bien délimitées; l'antérieure proportionnellement bien développée; son angle extérieur rectangulaire, arrondi; surface de l'oreillette ornée de côtes régulières, concentriques. Oreillette postérieure très courte, obtuse. Sur la région postérieure de la valve une dépression peu profonde. Auprès du crochet quelques plis concentriques, très faibles et un peu irréguliers. Reste de la surface lisse, ou, dans une valve extraordinairement bien conservée, orné, vers le bord postérieur, de stries rayonnantes, obliques, extrèmement fines.

Toutes les coquilles étant plus ou moins défectueuses, il n'est pas possible de préciser leurs dimensions. Une valve droite à peu près complète a environ 6 mill. de longueur et 7 mill. de hauteur.

On distingue aisément notre espèce du *Chl. monotiformis* par ses oreillettes bien délimitées et par l'angle plus petit de ses bords latéraux; en outre l'ornementation de la valve gauche est différente dans les deux espèces. Le *Chl. hennigi* est assez voisin du *Pecten simplicius,* trouvé dans le »Ripleyan« de l'Amérique du Nord; il s'en distingue par son sinus du byssus beaucoup plus profond.

J'ai dédié l'espèce à mon ami défunt, le géologue suédois Anders Hennig, qui s'occupait de l'étude des dépôts crétaciques de la Scanie.

Calcaire à Coralliaires: 2 valves droites (dont l'une est un peu douteuse) et 6 valves gauches, dont deux trouvées dans le »Nez«.

Famille: **Spondylidae.**

Genre: **Spondylus** Linné (1758).

Dans le Calcaire à coralliaires du »Nez« on a trouvé 3 valves isolées et 1 individu à deux valves. Ils sont très jeunes, jusqu'à 2 mm de hauteur, et leur ornementation rappelle fortement celle du genre *Plicatula;* mais la structure de la charnière montre qu'il faudra les rapporter au genre *Spondylus.* Pour le moment il est impossible de déterminer s'ils se rapportent à l'une des deux espèces antérieurement décrites de Faxe ou si, éventuellement, ils se réfèrent à une troisième espèce.

30. **Spondylus dutempleanus** d'Orb.

(Voir 1902. Ravn, Mollusk. i Danmarks Kridtafl. I. p. 107; pl. II, fig. 22 et 25).

Calcaire à Coralliaires: 1 individu.

31. **Spondylus faxensis** (M.U.H.), Ldgrn.

(Voir 1902. Ravn, Mollusk. i Danmarks Kridtafl. I. p. 107; pl. III, fig. 1—3).

Calcaires à Coralliaires et à Bryozoaires: assez abondant.

Famille: **Anomiidae.**

Genre: Anomia Linné (1758).

32. **Anomia** sp.

Quelques coquilles, partiellement très petites, ont dû se référer à une ou peut-être plusieurs espèces du genre *Anomia*, mais les matériaux sont trop incomplets pour permettre une détermination quant à l'espèce.

Calcaire à Coralliaires: 4 coquilles. — Calc. à Bryozoaires: 2 coquilles.

Famille: **Ostreidae.**

Genre: Ostrea Linné (1758).

33. **Ostrea semiplana** Sow.

(Voir 1902. Ravn, Mollusk. i Danmarks Kridtafl. I. p. 113; pl. III, fig. 5 et 7—8).

Calcaire à Bryozoaires: assez rare.

34. **Ostrea hippopodium** Nilss.

(Voir 1902. Ravn, Mollusk. i Danmarks Kridtafl. I. p. 114).

Calcaires à Coralliaires et à Bryozoaires: assez rare.

35. **Ostrea reflexa** (M.U.H.), Ravn.

(Voir 1902. Ravn, Mollusk. i Danmarks Kridtafl. I. p. 115; pl. III, fig. 12—14).

Calcaires à Coralliaires et à Bryozoaires: très rare.

Genre: Gryphaea Lamk. (1801).

36. **Gryphaea vesicularis** Lamk.

(Voir 1902. Ravn, Mollusk. i Danmarks Kridtafl. I. p. 116).

Calcaires à Coralliaires et à Bryozoaires: abondante.

Genre: Exogyra Say (1819).

37. **Exogyra canaliculata** (Sow.).

Pl. I, fig. 11 a—b.

1902. *Exogyra lateralis* (Nilss.); Ravn, Mollusk. i Danmarks Kridtafl. I. p. 118.
1913. *Ostrea canaliculata* (Sow.); Woods, Cret. Lamellibr. II. p. 375; pl. 56, fig. 2—16.
1930. — *(Gryphostrea) canaliculata* (Sow.); É. Vincent, Mollusq. montiens. p. 78; pl. 4, fig. 8.

Pour la liste synonomique détaillée nous référons au travail de Woods.

Le Calcaire à Coralliaires du »Nez« nous a fourni un grand nombre de coquilles de cette espèce, dont la plupart, cependant, sont plus ou moins défectueuses. Les exemplaires les plus petits ont un diamètre d'environ 1 mm. La plupart en sont des valves droites, facilement reconnaissables par leurs lamelles concentriques à la surface.

Vincent identifie cette espèce avec *Ostrea eversa* Mellev. du paléocène belge et français. Les exemplaires que j'ai vus de cette dernière espèce semblent toutefois indiquer que notre espèce se distingue facilement d'*O. eversa* par son infériorité en hauteur et par sa forme ovale.

Famille: **Mytilidae.**

Genre: Septifer Récluz (1848).

38. **Septifer lineatus** (Sow.).

1902. *Modiola Cottae* (Röm.); Ravn, Mollusk. i Danmarks Kridtafl. I. p. 118; pl. III, fig. 6.
1900. *Septifer lineatus* (Sow.); Woods, Cret. Lamellibr. I. p. 106; pl. 18, fig. 1—12.

Woods identifie, bien qu'avec une certaine réserve, *Mytilus Cottae* de Römer et *Modiola lineata* décrite auparavant par Sowerby, laquelle il rapporte au genre *Septifer* parce que, dans quelques moules internes, il a observé des empreintes d'une lame septiforme sous le crochet. Chez les exemplaires de Faxe je n'ai pas pu observer sûrement une telle empreinte. Comme, toutefois, l'identité des deux formes peut être considérée comme indubitable j'ai trouvé juste de rapporter l'espèce au genre *Septifer*. D'après É. Vincent (Couches mont. d'Eysden, p. 13) elle serait identique à *Modiola* (*Brachyodontes*) *ciplyensis* Ryck.

Au »Nez« on n'a pas trouvé de coquilles de cette espèce, mais autrement elle est assez abondante dans le Calcaire à Coralliaires aussi bien que dans le Calc. à Bryozoaires.

Genre: Lithodomus Cuv. (1817).

39. **Lithodomus rugosus** d'Orb.

(Voir 1902. Ravn, Mollusk. i Danmarks Kridtafl. I. p. 120; pl. IV, fig. 2—3).

Calcaire à Coralliaires: très rare.

C. Gastropodes.

Famille: **Pleurotomariidae.**

Genre: Pleurotomaria Defr. (1821).

40. **Pleurotomaria niloticiformis** (Schloth.).

Pl. I, fig. 10.

(Voir 1902. Ravn, Mollusk. i Danmarks Kridtafl. II. p. 214; pl. I, fig. 3—4).

Cette espèce est représentée maintenant par un très grand nombre d'individus, dont le test est en apparence conservé au total ou en partie. Toutes ces coquilles sont petites; un certain nombre d'entr'elles représentent peut-être la pointe de coquilles plus grandes. Chez une seule coquille on voit encore l'entaille, qui a été assez profonde, comprenant à peu près un tiers du dernier tour (fig. 10). Il apparaît maintenant que le phénomène mentionné dans la description citée plus haut, à savoir que la bande du sinus est invisible sur le premier tour n'est pas dû au fait d'être cachée ici par le tour suivant. Peut-être qu'elle n'a pas été développée du tout sur le premier tour; ce n'est qu'un peu après le commencement du second tour qu'on la voit nettement, marquée par une dépression se produisant assez subitement. Sur les trois premiers tours elle est proportionnellement bien enfoncée; aux tours suivants elle s'aplatit de plus en plus en même temps que l'ornementation transverse s'affaiblit, en premier lieu sur la part du tour située au-dessus de la bande.

Auparavant déjà j'ai fait ressortir que les nombreux moules internes qui se trouvent dans le Calcaire de Faxe, varient tellement qu'il est probable que nous nous trouvons en réalité en présence de plusieurs espèces. Ceci est corroboré encore par le fait qu'on a trouvé un tout petit exemplaire dont le sommet embryonnaire diffère beaucoup de celui de l'espèce décrite ici.

Calcaire à Coralliaires: de nombreux individus au test en apparence bien conservé.

Genre: Scissurella d'Orb. (1823).

41. **Scissurella annulata** n. sp.

Pl. I, fig. 14 a—c.

Très petite coquille planorbiforme. Surface supérieure aplatie; sommet de la spire un peu enfoncé. Coupe transversale des tours circulaire. Surface ornée de côtes nombreuses, étroites, assez fortes, un peu recourbées sur le bord extérieur des tours. Sur la surface supérieure, auprès de la périphérie, une fissure (ou une bande du sinus), subitement prenant naissance un peu en avant du commencement du deuxième tour; fissure limitée par des bords élevés. Surface inférieure de la coquille munie d'un ombilic large et profond.

La coquille figurée a la hauteur d'environ 0,6 mill. et le diamètre de 1,4 mill.

Cette espèce se distingue des espèces décrites du bassin de Paris par sa forme aplatie et par l'absence complète d'ornementation spirale.

Le »Nez«: 9 individus.

Famille: **Fissurellidae.**

Genre: Emarginula Lamk. (1801).

42. **Emarginula coralliorum** (M. U. H.) Ldgrn.

Pl. I, fig. 13 a—b.

(Voir 1902. Ravn, Mollusk. i Danmarks Kridtafl. II. p. 213; pl. I, fig. 1—2).

Dans ma description citée plus haut j'ai déjà fait remarquer que la forme des moules peut varier assez considérablement. Nous avons aujourd'hui sous la main un certain nombre de coquilles présentant une variation semblable mais qui, autrement, correspondent à la description. On pourra encore ajouter ici que le nombre des côtes primaires est, le plus souvent, de 18 à 22.

Dimensions de la coquille figurée: Hauteur, 3,2 mm; diamètres de l'ouverture, 4,7 et 3,0 mm.

Le »Nez«: 11 individus; en dehors de cela, des exemplaires en grand nombre tant du Calcaire à Coralliaires que du Calc. à Bryozoaires.

43. **Emarginula** sp.

Un seul moule interne diffère beaucoup des moules de l'espèce précédente. Il est surtout beaucoup plus large et moins fortement bombé, en sorte que le sommet du crochet est situé beaucoup en dedans du bord postérieur de la coquille. On ne possède qu'une très petite part du moule externe de la coquille; il apparaît que l'ornementation a consisté en côtes aux intervalles ornés de séries de fossettes. Les matériaux en présence suffisent à peine pour déterminer l'espèce.

Hauteur du moule, 5,5 mm; diamètres de l'ouverture, respectivement 13,5 et 9,5 mm.

Calcaire à Bryozoaires: 1 individu.

Genre: Fissurella Brug. (1789).

44. **Fissurella** sp.

Un seul moule est à rapporter à une espèce du genre *Fissurella*. Il est conique, assez bas, au sommet central pointu. Ouverture ovale, un peu plus étroite du côté antérieur qu'en arrière. La perforation a la forme d'un ovale allongé, un peu au-devant du sommet. Le moule indique tant des plis relativement accentués que des traces d'une ornementation rayonnante.

Hauteur du moule, 4,5 mm; diamètres de l'ouverture, respectivement 9 et 6 mm.

L'ornementation étant inconnue l'espèce de cet individu ne peut être déterminée.

Calcaire à Coralliaires: 1 moule interne.

Famille: **Turbinidae.**

Genre: Collonia Gray.

45. **Collonia (Circulopsis) pusilla** n. sp.

Pl. I, fig. 15 a—c.

Petite coquille discoïdale, composée de 3 à 4 tours. Spire déprimée, à nucléus assez grand; tours convexes, à sutures parfois un peu indistinctes; dernier tour très grand, embrassant à peu près toute la coquille, aplati auprès de la suture, arrondi à la périphérie et un peu plus aplati à la base. Surface de la coquille apparemment lisse, mais en réalité couverte, sous la suture, de plis transverses, extrèmement fins, et de spiraux très minces, dont ceux de la base les plus distincts. Cavité ombilicale profonde, munie à son bord de 8 à 10 plis forts. Ouverture circulaire, à péristome continu et à profil presque rectiligne; labre externe tranchant; péristome comme redoublé vers l'ombilic par une dilatation, séparée du bord par un sillon et cachant une petite partie de l'ombilic et du tour précédent.

Hauteur, 1,7 mill.; diamètre, 2,8 mill.

Quelques coquilles plus petites ont ordinairement l'ombilic un peu plus large et le péristome pas complètement continu; mais du reste elles semblent s'accorder bien avec la forme ici décrite; probablement elles représentent les jeunes individus de la même espèce.

La *C. pusilla* paraît très voisine de la *C. megalomphalus* Cossm.; elle s'en distingue par sa taille plus petite, par sa forme plus basse et par son ornementation beaucoup plus fine.

Le »Nez«: 103 individus.

Genre: Leucorhynchia Crosse (1867).

46. **Leucorhynchia marginata** n. sp.

Pl. II, fig. 1 a—c.

Petite coquille déprimée, composée de 4 tours peu convexes, croissant rapidement, séparés par une suture assez profonde. Spire peu saillante. Sous la suture une bande convexe, étroite, vers le bas délimitée par une dépression distincte. Tours à peu près lisses, ne montrant que des stries d'accroissement très fines et très obliques.

Tour dernier très grand, arrondi; base peu convexe. Ouverture arrondie, entière, circulaire, épaissie, à profil rectiligne et peu oblique par rapport à l'axe de la coquille; labre externe muni en haut d'un épaississement fort, descendant jusqu'au labre interne et séparé du bord du péristome par un sillon bien marqué; labre interne muni en bas d'une saillie épaisse, linguiforme, couvrant la plus grande partie de l'ombilic et passant lentement à la base. Ombilic assez étroit, mais profond; son bord montrant des saillies de grandeur différente, au nombre d'environ 8, séparées par des sillons visibles également au milieu de la base et ici parfois bifurquées. Base ornée encore de quatre lignes spirales, distinctes surtout sur la saillie linguiforme du labre interne.

Hauteur, 4 mill.; diamètre, 5 mill.

On serait peut-être porté à considérer la coquille décrite ici comme un exemplaire adulte de *Collonia pusilla*, attendu qu'elle ressemble beaucoup à cette espèce. Il serait pourtant très peu probable de n'avoir, dans le nombre de 104 coquilles, trouvé qu'une seule adulte. De plus, en se servant d'une forte loupe on voit presque toujours chez *C. pusilla* une très fine ornementation spirale à la surface extérieure de la coquille; et, d'autre part, la saillie linguiforme du bord columellaire et la bande étroite au-dessous de la suture font toujours défaut.

Le galbe de l'espèce rapelle beaucoup *L. callifera* (Desh.), mais l'espèce s'en distingue surtout par la bande au-dessous de la suture et par l'infériorité en dimension de la saillie linguiforme. Elle rappelle également dans une certaine mesure *L. nitida* Br. & Corn., mais cette espèce est beaucoup plus petite, et une beaucoup plus grande part de son ombilic est invisible.

Le »Nez«: 1 individu.

Famille: **Delphinulidae.**

Genre: Eucycloscala Cossm. (1893).

47. **Eucycloscala ultima** n. sp.

Pl. II, fig. 2 a—b.

Très petite coquille, turbinée, à spire courte et obtuse. Angle de la spire de 65° environ. Protoconque déprimée, composée d'un tour lisse, convexe. En outre trois tours bombés, séparés par une suture profonde. Ornementation composée de côtes axiales, lamelliformes, au nombre de 15 sur chaque tour, le plus souvent rectilignes et obliques, croisées de deux cordons extrêmement fins, presque invisibles. Base très convexe, pas délimitée en haut. Ombilic assez étroit, très profond, pas entouré d'une série de tubercules; côtes du dernier tour prolongées sur la paroi de l'ombilic. Ouverture circulaire, un peu oblique par rapport à l'axe de la coquille.

Hauteur, 2,3 mill.; diamètre, 2,0 mill.; hauteur du dernier tour, 1,7 mill.

L'espèce décrite ici semble plus conforme à *Eucycloscala* qu'à n'importe quel autre genre, mais l'ornementation spirale est plus faiblement développée et la base plus fortement bombée que c'est le cas ordinairement pour ce genre. Le défaut d'une série de tubercules sur le bord de l'ombilic est probablement dû à la délicatesse de l'ornementation spirale.

Calcaire à Coralliaires: 12 individus.

Genre: Delphinula LAMK. (1803).

48. **Delphinula (Pseudoninella) depressa** n. sp.

Pl. II, fig. 3 a—c.

Petite coquille turbinée, composée d'environ quatre tours. Partie supérieure de la spire aplatie, à la protoconque un peu enfoncée; partie suivante ornée de côtes transverses, fines, serrées, et, aussitôt après, de deux séries spirales de tubercules aigus, successivement changées en deux carènes à dents pointues. La surface des deux premiers tours à peu près au même plan; le tour suivant s'abaissant d'avantage; la coquille donc hélicoïde; en même temps toute l'ornementation des tours visible. Ces tours fortement bombés, au début aplatis vers le haut, plus tard plus uniformément bombés, ornés de trois carènes spirales munies de dents dirigées un peu en avant; à la partie tout à fait inférieure du tour une série de tubercules à dents, très petites au début, plus tard à peu près de la même grosseur que les dents des trois carènes spirales. L'ornementation spirale entrecoupée de stries transverses très nombreuses, serrées, relevées, développées le plus fortement dans les rainures entre les carènes. — Dernier tour s'abaissant assez fortement vers l'ouverture, uniformément bombé mais à base aplanie; base munie de 4 spirales en forme de fils de perles, la plus intérieure constituant la limite du côté de l'ombilic, les deux moyennes un peu plus faibles; du côté de l'ouverture, des spirales plus délicates intercalées entre les primaires. Ombilic assez large, dans une certaine mesure caché par le péristome; sur la paroi de l'ombilic, vers le milieu du dernier tour, une spirale granuleuse. Ouverture circulaire, presqu'entièrement dégagée, ayant seulement une petite part en contact avec l'avant-dernier tour; le bord de l'ouverture assez tranchant, mais un peu audedans du bord un épaississement notable.

Hauteur, 4,5 mm; diamètre, 5,7 mm; diamètre de l'ouverture, environ 3 mm.

L'espèce est très voisine de *D. bronni* PHIL. de l'oligocène inférieur de l'Allemagne du Nord, mais elle est notamment relativement plus basse que celle-ci.

Calcaire à Coralliaires: 71 individus.

Famille: **Trochidae.**

Genre: Monodonta LAMK.

49. **Monodonta (Danilia) faxensis** n. sp.

Pl. II, fig. 4 a—c.

Petite coquille turbiniforme formée de cinq tours. Angle de la spire environ 68°. Tours convexes, séparés par une suture très distincte et approfondie; premier tour lisse; tour suivant orné de côtes transverses obliques, proportionnellement grosses; dès l'origine du troisième tour deux arêtes spirales, dont la supérieure située vers le milieu du tour, l'inférieure tenant le milieu entre la supérieure et la suture inférieure; à l'intersection des arêtes et des côtes transverses un nœud fort, aigu; en outre, au-dessus de l'arête supérieure, d'abord un et plus tard deux nœuds plus petits sur chaque côte; de plus, sous la loupe, des stries transverses très fines, souvent croisant les côtes; avant-dernier tour muni de côtes transverses au nombre d'environ 16. Dernier tour à bord arrondi vers la base assez convexe, munie de huit spiraux granuleux; d'ailleurs l'ornementation du dernier tour comme celle des tours précédents, mais complétée d'un cordonnet spiral mince au-dessus et d'un deuxième au-dessous de la série la plus inférieure de nœuds. Pas d'ombilic. Ouverture subcirculaire; bord du labre externe tranchant, faiblement dentelé par les cordonnets spiraux, formant un angle d'environ 45° avec la suture; un peu au dedans du bord un épaississement irrégulièrement dentelé. Columelle un peu excavée, se terminant en bas par une saillie petite, dentiforme, séparée de la dent la plus inférieure du labre par une incision distincte.

Hauteur, 4,5 mill.; diamètre, 3,2 mill.; hauteur de l'ouverture, 1,8 mill.

Cette espèce est voisine de la *M. perelegans* Desh., mais elle s'en distingue par ses côtes beaucoup plus grosses et surtout par l'ornementation bien différente (beaucoup plus fine) de sa base.

Le »Nez«: 100 individus.

50. **Monodonta (Danilia) quadricordata** n. sp.

Pl. II, fig. 5 a—c.

Petite coquille turbiniforme, composée de cinq tours assez convexes, séparés par une suture bien visible, approfondie. Angle de la spire environ 65°. Nucléus assez grand. Le premier tour et demi enroulé en un plan. Premier tour lisse; tours suivants ornés de côtes transverses, successivement assez tranchantes et plus obliques; dès le troisième tour deux cordonnets spiraux, étroits; plus tard quatre (rarement cinq) cordonnets, assez équidistants; à l'intersection des cordonnets et des côtes un petit nœud dentiforme: nœuds des quatre séries spirales pas toujours alignés dans le sens axial, les côtes transverses étant un peu sinueuses et, sur la région inférieure du tour, parfois bifurquées; nombre des côtes de l'avant-dernier tour, 22. Dernier tour arrondi vers la base: base imperforée, très convexe, ornée de huit filets spiraux délicats, croisés de costules nombreuses, minces, serrées et ainsi subgranuleuses; ornementation parfois bien affaiblie vers l'ouverture. Ouverture circulaire. Labre externe tranchant, subdentelé, fortement épaissi et indistinctement plissé à l'intérieur. Columelle faiblement excavée, aux dents indistinctes.

Hauteur, 5 mill.; diamètre, 3,9 mill.; hauteur de l'ouverture, 2,2 mill.

Quant à l'ornementation cette espèce ressemble beaucoup au *Turbo propinquus* Kaunhowen de la Craie de Maëstricht, mais elle a les tours plus convexes et l'ouverture d'une forme différente. Elle se distingue de l'espèce précédente surtout par sa protoconque plate et les quatre cordonnets.

Le »Nez«: 20 individus.

51. **Monodonta (Danilia) fenestrata** n. sp.

Pl. II, fig. 8 a—c.

Petite coquille turbinée, à protoconque courte et un peu obtuse. Angle de la spire environ 67°, décroissant vers le bas. Nucléus assez grand; tours assez convexes, au nombre de quatre à cinq, séparés par une suture profonde; tour premier lisse, proéminent; tours suivants ornés de costules transverses assez tranchantes, serrées, obliques, croisées sur les tours derniers de filets spiraux, très étroits, équidistants, au nombre de cinq sur l'avant-dernier tour; surface de la coquille ainsi délicatement treillissée. Tour dernier arrondi vers la base. Base subombiliquée dans les jeunes individus, imperforée dans les adultes, ornée d'environ dix filets spiraux minces, granuleux, croisés de filets transverses, très délicats. Ouverture quadrangulaire, arrondie. Labre externe tranchant, subdentelé, épaissi à l'intérieur, faiblement plissé en bas; columelle un peu excavée, se terminant en bas par une saillie petite séparée du pli inférieur du labre par une incision.

Hauteur, 3,2 mill.; diamètre, 2,4 mill.; hauteur de l'ouverture, 1,4 mill.

Probablement l'espèce est voisine de la *M. compsa* Cossm.; elle s'en distingue par ses cordonnets spiraux beaucoup plus fins et par ses costules plus grosses.

Le »Nez«: 159 individus.

52. **Monodonta (Osilinus) carinata** n. sp.

Pl. II, fig. 6 a—d et 7 a—d.

Petite coquille turbinée, globuleuse, à spire obtuse, composée de trois à quatre tours croissant rapidement. Premier tour enroulé en un plan, les tours suivants s'abaissant de plus en plus, munis à leur milieu d'un angle assez tranchant, divisant la surface en deux rampes; rampe supérieure plate, successivement plus déclive; rampe inférieure également plate, mais presque verticale. Tours ornés de filets spiraux fins, serrés, au nombre de cinq sur chaque rampe; dernier tour plus arrondi, surtout au-dessous de l'angle; son angle moins proéminent; sa surface ornée de filets spiraux nombreux. Base délimitée par une carène très arrondie et, dans les jeunes individus, munie d'un ombilique, couvert, dans les adultes, du labre interne. Ouverture subcirculaire, un peu quadrangulaire; labre externe tranchant, assez épaissi au dedans du bord, lisse à l'intérieur. Columelle un peu excavée en haut, formant, en bas, une saillie distincte, arrondie, au dehors de laquelle une dépression étroite, ressemblant parfois à une petite fente ombilicale.

Hauteur et diamètre 2,5 mm.

Cette espèce se caractérise surtout par la carène spirale marquée et elle se distingue par là facilement des autres espèces trouvées à Faxe et, du reste, aussi de toutes les autres espèces du genre *Monodonta* connues par moi, ainsi p. ex. de

M. staadti Cossm. Pour le galbe et l'ornementation elle rappelle beaucoup certaines espèces du genre *Solariella* Wood, mais les individus adultes ne possèdent pas l'entonnoir ombilical.

Le »Nez«: 644 individus.

Genre: Eumargarita Fischer (1885).

53. **Eumargarita brünnichi** n. sp.

Pl. III, fig. 11 a—c.

Petite coquille hélicoïde, à spire peu proéminente, composée d'environ trois tours convexes, croissant rapidement, séparés par une suture parfois peu distincte. Surface complètement lisse. Dernier tour très grand, arrondi vers la base. Base un peu convexe, s'abaissant vers l'ombilic assez étroit, mais profond, pas délimité par un bord. Péristome circulaire; ouverture très oblique par rapport à l'axe de la coquille. Labre externe tranchant; une petite part couverte par le labre interne.

Hauteur 1,7 mm; diamètre 2,7 mm.

L'espèce ici décrite ressemble assez bien à l'*E. bellii* Harm. du Coralline Crag, mais elle est plus petite, et elle a la spire plus basse et l'ombilic plus étroit. De l'*E. margaritula* (Mér.) de l'oligocène de Mayence elle se distingue par sa hauteur plus grande et par sa spire plus aiguë.

Le »Nez«: 310 individus.

Genre: Basilissa Watson (1879).

54. **Basilissa? tricincta** n. sp.

Pl. III, fig. 4 a—b.

Petite coquille trochoïde, composée de cinq à six tours. Angle de spire 45°. Protoconque obtuse, à nucléus déprimé. Tours complètement plans, séparés par des sutures bien approfondies; leur hauteur un peu au-dessus du tiers de leur diamètre moyen. Ornementation composée de trois cordonnets spiraux, équidistants, dont le supérieur un peu plus gros que les autres, croisés de nombreuses costules étroites; sur l'avant-dernier tour trois cordonnets secondaires, le supérieur situé au-dessous du cordonnet principal supérieur. A l'intersection des cordonnets et des costules un nœud assez fort. La hauteur du dernier tour à peu près deux tiers de la hauteur totale, au bord arrondi vers la base; base plate, ornée de nombreux filets spiraux; ombilic profond, étroit, circonscrit d'un bourrelet faiblement crénelé. Péristome discontinu; ouverture obliquement quadrangulaire, plus large que haute; columelle courte, oblique, tronquée en bas par un petit pli(?).

Hauteur 3,3 mm; diamètre 2,4 mm; hauteur du dernier tour 2 mm.

L'ouverture du seul exemplaire en présence n'étant pas complètement conservée on ne peut, certes, pas rapporter l'espèce tout à fait sûrement au genre *Basilissa*, mais tant pour le galbe que pour l'ornementation il rappelle très fortement *B. coss-*

manni TATE, mais les tours de celle-ci possèdent une ornementation spirale beaucoup plus fine et 4 cordonnets spiraux.

Habituellement l'espèce rappelle beaucoup *Mathildia rosenkrantzi* n. sp. décrite plus bas, mais elle s'en distingue e. a. par ses tours absolument plats et sa base également tout à fait plate.

Le »Nez«: 1 coquille.

Famille: **Cyclostrematidae.**

Genre: Tinostoma H. & A. ADAMS (em. 1853).

55. **Tinostoma glaberrimum** n. sp.

Pl. II, fig. 9 a—c.

Assez petite coquille discoïdale, à spire très courte, composée de tours peu nombreux, très bas, lisses, croissant rapidement; suture indiquée seulement par une dépression basse. Dernier tour très grand, arrondi vers la base, embrassant presque toute la coquille; base subconvexe, toutefois subconcave au milieu, une callosité indistinctement délimitée couvrant complètement l'ombilic. Ouverture circulaire; bords du péristome situés dans un plan incliné par rapport à l'axe de la coquille; labre externe tranchant, incliné d'environ 45° par rapport à la suture.

Hauteur 2,6 mm; diamètre 6 mm.

Outre la coquille décrite ici on possède un certain nombre d'autres coquilles beaucoup plus petites, qui semblent se rapporter à la même espèce. Chez quelques-unes de ces coquilles l'ombilic n'est pas entièrement rempli de callosité.

Cette espèce se distingue facilement des espèces décrites du montien belge, par sa forme beaucoup plus aplatie. Des espèces de l'éocène français elle se distingue surtout par la suture très peu visible et par l'ouverture circulaire.

Le »Nez«: 7 individus.

56. **Tinostoma (Solariorbis)** n sp.?

Un petit nombre de fragments sont probablement à rapporter au sous-genre *Solariorbis*, mais ils sont tellement défectueux qu'il est impossible d'en donner une description tant soit peu complète. La coquille a eu la forme d'un disque épais, et elle est constituée d'un petit nombre de tours augmentant rapidement en diamètre. A la périphérie du dernier tour on voit un fort cordon creux qui, sur les tours précédents, se trouve immédiatement au-dessus de la suture inférieure; au-dessous de la suture supérieure on voit une légère dépression. La surface est ornée de stries spirales serrées, très fines, un peu plus grosses à la base du dernier tour. Ombilic large.

Le »Nez«: fragments de 3 individus.

Famille: **Patellidae.**

Genre: Patella Linné (1757).

57. **Patella?** sp. (I).

Un moule interne est trop incomplet pour en déterminer l'espèce; il n'est pas même possible de déterminer le genre tout à fait sûrement. Pour le galbe surtout il rappelle beaucoup *Acmaea dutemplei* (Desh.), mais il est beaucoup plus grand que celle-ci, et l'apex est situé beaucoup moins excentriquement. A l'apex les côtés forment un angle d'environ 100°. On ne possède malheureusement pas le moule externe, ce qui fait que l'ornementation n'est pas connue.

Hauteur du moule, 9 mm, son diamètre respectivement 25 et 20 mm.

Calcaire à Coralliaires: 1 moule interne.

58. **Patella?** sp. (II).

Un moule interne un peu défectueux est peut-être à rapporter au genre *Patella*, mais il appartient sans doute à une autre espèce que le moule décrit plus haut. Il s'en distingue surtout par le fait que la coquille a été plus aplatie, les côtés formant un angle de 125° à l'apex. A la région postérieure du moule il y a en outre une partie légèrement déprimée s'étendant de l'apex jusqu'au bord postérieur. La surface extérieure de la coquille semble avoir été munie de côtes rayonnantes.

Calcaire à Coralliaires: 1 moule interne.

Famille: **Solariidae.**

Genre: Solarium Lamk. (1799).

59. **Solarium faxense** n. sp.

Pl. III, fig. 1 a—c et 2 a—c.

Assez petite coquille, discoïdale, à spire très basse, conique et à base subconvexe. Protoconque lisse, composée de deux tours tubulaires, dont le premier invisible du côté de la face supérieure; délimitation de la protoconque très distincte, indiquée par un épaississement annulaire. Spire le plus souvent un peu étagée, à tours plans, séparés par une suture canaliculée; région moyenne des tours déprimée, subconcave. Surface des tours ornée de quatre cordonnets granuleux, les deux supérieurs situés au-dessus, les deux inférieurs au-dessous de la région déprimée, croisés de plis faibles, irréguliers, très obliques; le supérieur et l'inférieur des cordonnets les plus forts; en outre, sous la loupe, un nombre de cordonnets très fins, dispersés sur le tour entier. Bord du dernier tour formant une carène arrondie. Base un peu convexe, ornée, près du bord extérieur, d'un cordonnet mince et, sous la loupe, de spiraux encore plus fins, croisés de stries fines et de sillons plus gros. Bord de l'ombilic grossièrement crénelé. Ombilic assez étroit; sa paroi munie, à peu près au milieu du tour dernier, d'une carène crénelée. Ouverture quadrangulaire, à sinuosités faibles, correspondant au bord et à la carène de l'ombilic.

Hauteur, 3 mm; diamètre, 5 mm; diamètre de l'ombilic, 2 mm. Quelques autres exemplaires sont plus grands.

L'espèce ici décrite ressemble beaucoup au *S. staadti* Cossm., mais cette espèce a le bord extérieur plus aigu et l'ornementation de la base plus grosse. Quant au galbe notre espèce est voisine du *S. plicatulum* Desh., mais la base de cette espèce est tout différemment ornée. Du *S. selandicum* Ravn du Calcaire à Cérithes on distingue le *S. faxense* par sa spire plus basse et plus étagée et par ses tours moins concaves.

Le »Nez«: 32 individus.

60. **Solarium poulseni** n. sp.

Pl. III, fig. 5 a—c.

Assez petite coquille discoïdale, à spire presque plane, subétagée et à base assez convexe. Protoconque lisse, distinctement délimitée, au premier tour caché en partie. Tours séparés par une suture subcanaliculée, à surface subconcave, ornés de cordonnets d'une ténuité variable, croisés de stries très obliques et pour cette raison faiblement crénelés. Bord du dernier tour un peu élevé. Base uniformément convexe et ornée, un peu au-dessous du bord, d'un cordonnet assez fort et de plusieurs spiraux plus ou moins fins, croisés de stries d'accroissement presque rectilignes. Bord de l'ombilic uniformément crénelé; ombilic assez large, muni d'une carène spirale assez proéminente à la région supérieure des tours. Forme de l'ouverture inconnue.

Hauteur, 2,6 mm; diamètre, 6 mm; diamètre de l'ombilic, 3,5 mm.

Malgré son ornementation assez faiblement développée cette espèce doit probablement être rapportée au groupe de *Nipteraxis* Cossm. Quant au galbe elle ressemble beaucoup au *S. plicatum* Lamk.; elle s'en distingue par son ombilic beaucoup plus large et par sa base plus lisse.

Le »Nez«: 1 individu.

Famille: **Littorinidae.**

Genre: Littorinopsis Beck (*fide* Mørch, 1876).

61. **Littorinopsis faxensis** n. sp.

Pl. III, fig. 3 a—b.

Très petite coquille, ovoïde, courte, à spire élevée, composée de peu de tours assez convexes, croissant rapidement, séparés par une suture profonde et couverts de spiraux très fins, dont le supérieur délimité en bas par un sillon spiral assez profond. Dernier tour très grand, chez les individus jeunes faiblement anguleux à la périphérie de la base. Base imperforée, subconvexe, sans canal. Ouverture large, ovale. Labre externe mince, oblique, subrectiligne, antécurrent vers la suture. Columelle faiblement courbée, se raccordant au labre externe par un contour ininterrompu.

Hauteur, 2 mm; diamètre, 1,5 mm.

Les individus de cette espèce qu'on a trouvés jusqu'ici, se distinguent des autres espèces connues notamment par leur taille minimale. Mais les coquilles sous les yeux appartiennent probablement à des individus jeunes, ce qui rend la comparaison difficile. Notre espèce semble ressembler le plus à la *L. subangulata* (Desh.); elle s'en distingue par son galbe plus élevé et ses tours plus plans.

Le »Nez«: 4 individus.

Famille: **Capulidae.**

Genre: Hipponyx Defr. (1819).

62. **Hipponyx** sp. (I).

Une couple de moules internes un peu défectueux proviennent d'une espèce du genre *Hipponyx*. La coquille a été enroulée d'une manière égale à celle de *H. tuba* Desh. Le moule porte des empreintes de nombreux plis concentriques plus ou moins prononcés, de même qu'on y observe des traces d'une striure rayonnante.

Un autre moule plus petit a probablement appartenu à la même espèce; ici les plis concentriques se sont apparemment présentés à intervalles plus réguliers.

Calcaire à Coralliaires: 2 individus. — Calc. à Bryozoaires: 1 individu.

63. **Hipponyx** sp. (II).

Une couple de moules coniques et assez bas, qui semblent un peu asymétriques et sont munis d'un crochet pointu, dirigé un peu en arrière, et d'un galbe presque circulaire, sont probablement à rapporter au genre *Hipponyx*. On y observe des traces de l'impression musculaire en fer à cheval.

Calcaire à Bryozoaires: 2 individus.

Genre: Crepidula Lamk. (1799).

64. **Crepidula** sp. (I).

Quelques moules en forme de bonnet ne se laissent guère déterminer quant à l'espèce. L'un d'eux rappelle pour le galbe et les dimensions *Cr. janeti* Cossm., mais il est plus bombé et, de plus, son septum a été plus fortement convexe.

Calcaire à Bryozoaires: 1 individu.

65. **Crepidula** sp. (II).

Une couple des moules cités plus haut présentent un galbe qui nécessite de les rapporter à une espèce différente de la précédente. Ils sont fortement bombés, à section subcirculaire. Le septum a été fortement développé.

Calcaire à Coralliaires: 2 individus.

66. **Crepidula** sp. (III).

Un petit moule se distingue considérablement des moules cités auparavant. Il est très allongé, fortement bombé et resserré. Le septum semble avoir été bien développé.

Calcaire à Bryozoaires: 1 individu.

Famille: **Naticidae.**

Genre: Tylostoma Sharpe (1849).

67. **Tylostoma ampullariaeforme** Ravn.

(Voir 1902. Ravn, Mollusk. i Danmarks Kridtafl. II. p. 217; pl. I, fig. 7—9).

On n'a recueilli que très peu de nouveaux matériaux de cette espèce. A la description citée plus haut on ne fera qu'ajouter qu'elle est très voisine de *T.*? *ciplyense* de Poudingue de Ciply décrit par É. Vincent; mais, comme l'a indiqué déjà Vincent, cette espèce a son dernier tour moins bombé, la spire plus élancée et l'angle apical plus petit.

Calcaires à Coralliaires et à Bryozoaires: 29 individus.

Famille: **Scalariidae.**

Genre: Acrilla H. Adams (1860).

68. **Acrilla elegans** (Ravn).

1902. *Scalaria elegans* Ravn, Mollusk. i Danmarks Kridtafl. II. p. 218; pl. I, fig. 10.

Cette espèce n'a pas été augmentée de nouveaux matériaux. A la description antécédente on peut ajouter que le cordon spiral délimitant extérieurement le disque basal est légèrement dentelé.

L'espèce rappelle passablement *Scala Groenwalli* de Boury (= *Scalaria Mörchi* Grönw.) du paléocène du Jutland; mais cette espèce semble avoir les côtes transverses plus délicates, de même qu'elle a la base perforée, tandis qu'on ne voit pas trace de perforation chez notre espèce. — *A. elegans* se distingue de plusieurs espèces similaires de l'éocène par le fait que les cordons spiraux traversent les côtes sans aucune interruption. Chez *Scalaria gallica* de Boury on ne voit pas de cordon spiral grossier immediatement au-dessus de la suture; de plus, les cordonnets spiraux de cette espèce sont beaucoup plus délicats et les côtes transverses plus tranchantes.

Le nom d'*elegans* a été donné auparavant à des espèces du genre *Scalaria s. l.*, mais, pour autant que je le sache, il n'a été donné à aucune des espèces du groupe aujourd'hui désigné comme le genre *Acrilla*. Il n'y a donc rien qui s'oppose à maintenir son nom à notre espèce.

Calcaire à Coralliaires: 5 individus.

Genre: Coniscala de Boury (1877).

69. **Coniscala faxensis** n. sp.

Pl. III, fig. 7.

Une seule coquille, certes, est assez incomplète, mais elle suffit pour faire voir qu'elle doit être rapportée à une espèce du genre *Coniscala* jusqu'ici indécrite.

Test proportionnellement mince; taille grande; forme conique. Tours très convexes, séparés par une suture profonde, bordée en haut d'un spiral distinct. Surface ornée de lamelles axiales fortes, étroites et tranchantes, au nombre d'environ 22 par tour; sous la suture les lamelles fortement recourbées, mais un peu plus bas presque verticales, un peu plus élevées au milieu du tour, croisées de spiraux assez forts, très nombreux. Dernier tour uniformément arrondi vers la base. Celle-ci bordée d'un cordon spiral, couverte d'un disque assez épais, et subconvexe, et ornée des lamelles prolongées du flanc du tour. Entonnoir ombilical assez large. Ouverture inconnue.

Hauteur du fragment figuré, 48 mm; diamètre, 32 mm.

L'espèce est assez rapprochée de *C. johnstrupi* (v. Koen.) du paléocène de »Vestre Gasværk« (usine à gaz, aujourd'hui abandonnée) à Copenhague; mais ses lamelles axiales sont plus délicates, proportionnellement plus tranchantes et étroites et, pour cette raison, en apparence plus espacées, et son ombilic est plus large; ce dernier est limité extérieurement par un bord moins tranchant que chez l'espèce paléocène, chez laquelle les lamelles sont moins recourbées en arrière audessous de la suture. — *C. persica* Douvillé du Maëstrichtien de la Perse possède e. a. des tours moins fortement convexes et des lamelles plus fortes. — Notre espèce ressemble encore beaucoup à *C. angariensis* de Ryckh. du Landénien belge; mais chez cette espèce le cordon délimitant la base n'est pas visible sur les tours relativement âgés et, de plus, les tours sont un peu plus bas.

Calcaire à Bryozoaires?: 2 individus.

Genre: Aclis Lovén (1846).

70. **Aclis (Graphis) danica** n. sp.

Pl. III, fig. 6 a—b.

Petite coquille subcylindrique. Protoconque courte, globuleuse, lisse, subdéviée. Spire composée de tours nombreux, bien convexes, séparés par une suture très profonde. Ornementation composée de côtes proportionnellement fortes, un peu courbées, au nombre d'environ 14 par tour. Ornementation spirale faisant défaut. Dernier tour bas, à base étroite, lisse, indistinctement délimitée, imperforée. Ouverture ovale, à bord mince.

Hauteur, 2,9 mm; diamètre, 0,7 mm; hauteur du dernier tour, 0,9 mm.

Parmi les espèces du bassin de Paris la forme décrite ici est sans doute le plus rapprochée de *A. minutissima* (Desh.), mais sa base est beaucoup plus bombée, et son ouverture est proportionnellement plus élevée. Elle rappelle aussi beaucoup *A. formosa* (Br. & C.) du Calcaire de Mons, mais celle-ci a les tours plus convexes et elle est un peu moins allongée.

Le »Nez«: 2 individus.

Genre: Tenuiscala de Boury (1887).

71. **Tenuiscala rosenkrantzi** n. sp.

Pl. III, fig. 8 a—b, 9 a—b et 10 a—b.

Très petite coquille subulée. Protoconque composée d'environ cinq tours lisses, bien convexes; les deux à trois premiers rapidement croissants, les suivants d'un diamètre presque égal. Tours de la spire assez convexes, surtout en bas, séparés par de profondes sutures; chaque tour orné de 10 à 11 costules axiales, fortes, un peu obliques, croisées de trois cordonnets spiraux assez gros, produisant des tubercules à leur intersection avec les costules; de plus, la suture bordée des deux côtés par un cordonnet spiral très fin. Base distinctement délimitée, plane, lisse. Ouverture probablement quadrangulaire, arrondie, se terminant en un petit bec aigu.

Hauteur d'un fragment figuré (fig. 10), 3,2 mm; diamètre, 0,4—0,7 mm; hauteur du dernier tour, environ 1 mm.

L'exemplaire de la fig. 8 a été choisi comme holotype. L'exemplaire de la fig. 9 a une protoconque un peu différente (plus conoïde); elle appartient pourtant très vraisemblablement à la même espèce que les autres.

L'espèce décrite ici doit apparemment être rapportée à *Cerithiscala* de Boury (1887), regardée par Cossmann comme une section du genre *Tenuiscala*. L'ornementation rappelle beaucoup celle de *T. renardi* (Br. & C.), mais cette espèce possède un plus grand nombre de cordons spiraux et ses costules axiales sont plus étroites. Elle a une ressemblance encore plus grande avec *T. diachorista* (de Boury), mais cette espèce possède 4 cordons spiraux et elle est beaucoup moins allongée que l'espèce danoise.

Le »Nez«: 60 individus.

72. **Tenuiscala (Cerithiscala) tricincta** n. sp.

Pl. III, fig. 12 a—b.

Petite coquille conique. Angle de spire 35°. Protoconque souvent un peu déviée, conique, aiguë, composée d'environ quatre tours convexes, dont les deux les plus jeunes ornés de costules axiales fines. Tours suivants assez convexes, séparés par une suture profonde. Ornementation composée de costules axiales élevées, tranchantes, droites ou un peu courbées, au nombre d'environ 12 par tour; de plus, au milieu du premier tour un cordonnet spiral fort; plus tard, au-dessous de celui-ci, un deuxième cordonnet un peu plus fin, et enfin un troisième aussi fin au-dessus du premier cordonnet, tous étroits et produisant des aspérités à leur intersection avec les costules. Base plane, bordée d'un cordonnet situé précisément dans la suture, et ornée de cordonnets forts et de stries d'accroissement plus ou moins fortes. Ouverture incomplètement conservée chez les coquilles sous les yeux, mais probablement arrondie, quadrangulaire.

L'exemplaire figuré a 3,3 mm de hauteur et 1,5 mm d'épaisseur. Quelques rares débris proviennent de coquilles un peu plus grandes.

Cette espèce rappelle sans doute le plus *T. quadricincta* (v. Koen.) d'oligocène inférieur de l'Allemagne, mais elle a un cordon spiral de moins. Les espèces connues du paléocène belge et de l'éocène français possèdent également des cordons spiraux plus nombreux que l'espèce danoise.

Le »Nez«: 10 individus.

Genre: Pliciscala de Boury (1887).

73. **Pliciscala** sp.

Un seul débris d'une petite coquille est à rapporter à ce genre, mais il est trop incomplet pour permettre une détermination de l'espèce. Il comprend deux tours assez fortement convexes et séparés par une suture profonde. A chacun d'eux 15 costules axiales peu élevées, arrondies et un peu sinueuses, de la même largeur à peu près que leurs intervalles, se terminant, auprès de la suture, en un petit tubercule; celui-ci se confond avec les tubercules de l'ombilic, ce qui donne naissance à un cordonnet spiral. De plus, à chaque tour, une varice épaisse; les deux varices sont placées à peu près bout à bout.

Le »Nez«: 1 individu.

Famille: **Vermitidae.**

Genre: Siliquaria Brug. (1789).

74. **Siliquaria ornata** (M. U. H.), Ldgrn.

(Voir 1902. Ravn, Mollusk. i Danmarks Kridtafl. II. p. 219; pl. I, fig. 11—12).

Le peu de matériaux qui est venu s'ajouter pour cette espèce, ne donne pas lieu à des remarques supplémentaires de la description citée ci-dessus.

Calcaire à Coralliaires: un nombre assez grand de débris de moules internes, partiellement à moules externes correspondants.

Famille: **Pyramidellidae.**

Genre: Odostomia Fleming (1828).

75. **Odostomia? selandica** n. sp.

Pl. III, fig. 13 a—b.

Très petite coquille, ovoïde, un peu allongée, composée de quatre tours. Protoconque déprimée, à nucléus caché. Tours subconvexes, séparés par des sutures distinctes et un peu approfondies, ornés de six cordonnets spiraux, fins, dont le supérieur plus fort que les autres, situé immédiatement au-dessous de la suture et bordé, en bas, d'un sillon spiral proportionnellement profond; cordonnets croisés de stries d'accroissement extrêmement fines. Dernier tour très grand, supérieur aux trois quarts de la hauteur totale, arrondi vers la base imperforée et ornée de cordonnets de la même nature que ceux des tours. Péristome discontinu. Ouverture ovale, légèrement versante; labre externe tranchant, un peu frangé, fortement antécurrent; columelle excavée; pli columellaire presque nul.

Hauteur, 2,6 mm; diamètre, 1,6 mm; hauteur du dernier tour, 2,0 mm.

Cette espèce ressemble beaucoup, e. a. pour l'ornementation, à *O. verneuilensis* de Rainc. et Mun. Ch. de l'éocène français, qui est muni cependant d'un pli très fort sur la columelle. Un tel pli se trouve également chez *O. conjungens* (Br. & C.). Par contre, le plis est très délicat chez l'espèce pliocène et récente *O. insculpta* Mont., qui est référée au sous-genre *Ondina*. Cette espèce est beaucoup plus allongée, pourtant, que notre espèce.

Le »Nez«: 3 coquilles.

Genre: Eulima Risso (1826).

76. **Eulima (Polygyreulima) danica** n. sp.

Pl. IV, fig. 1 a—b et 2 a—b.

Petite coquille turriculée, composée de 11 à 12 tours. Protoconque faiblement obtuse. Tours suivants subplans, lisses, séparés par des sutures presque invisibles; pas de cicatrices variqueuses. Dernier tour presque égal au tiers de la hauteur totale, arrondi vers la base. Ouverture étroite en haut, plus large en bas; labre externe raccordé par un angle droit avec la suture, au-dessous de celle-ci courbé un peu en avant et, tout en bas, courbé fortement en arrière; columelle oblique, un peu arquée, épaissie.

Hauteur, environ 8 mm; diamètre, 2 mm; hauteur du dernier tour, 2,8 mm.

A cette espèce sont référées un certain nombre de débris, dont quelques-uns sont trop incomplets, pourtant, pour permettre une détermination tout à fait sûre. L'espèce est assez rapprochée de *E. acumen* Desh., mais elle est un peu moins allongée, et son dernier tour est relativement plus bas; de plus, son labre externe est plus fortement courbé en bas. Pour le galbe, l'espèce rappelle beaucoup *E. planispira* Cossm. du Calcaire de Mons, mais cette espèce possède des sutures très apparentes.

Le »Nez«: 33 coquilles.

77. **Eulima** sp.

Des débris de deux coquilles sont trop incomplets pour une détermination de l'espèce. La coquille a été beaucoup plus grande que celle de l'espèce précédente, la longueur d'un des débris étant de 10 mm et son épaisseur au bout supérieur et à l'inférieur respectivement de 2 et 4 mm. Immédiatement au-dessous de la suture se voit une vague dépression, et ça et là se trouvent des varices, qui semblent démontrer que le labre externe a eu une forme pareille à celle de l'espèce précédente; ces varices ne sont pas rangées en deux séries longitudinales, comme c'est le fait pour le groupe de *Margineulima*, auquel la coquille ressemble très fortement, mais, au moins en apparence, en trois rangs obliques, avec cette réserve, toutefois, que pour chacun de ces rangs ce ne sont que tous les deux tours qui portent une varice.

Le »Nez«: 2 coquilles.

Famille: **Faxiidae** n. fam.

La *Faxia macrostoma* décrite ci-dessous appartient sans aucun doute à un genre nouveau, sous certains rapports tellement particulier qu'il ne se laisse référer à aucune des familles établies jusqu'ici mais qu'il est à considérer comme représentant une famille nouvelle, reconnaissable aux caractères suivants:

Coquille rissoïde. Tours séparés par des sutures distinctes et munis d'une bande du sinus au-dessous de la suture. Ouverture circulaire chez les individus jeunes; labre externe un peu proéminent sur le milieu, avec un sinus très profond en haut et une échancrure en bas; columelle rectiligne, sans plis. Chez les individus adultes ouverture principale très grande, à bord fortement réfléchi comme le pavillon d'une trompette, supérieurement appliqué sur le tour. A une certaine distance derrière l'ouverture le restant du sinus, visible comme une ouverture anale, limitée postérieurement par un bourrelet en forme de cratère, adoptant antérieurement la forme d'une fente étroite s'atténuant du côté de l'ouverture jusqu'à clôture complète. Sur la base le reste de l'échancrure formant comme une petite ouverture siphonale entourée d'un bord proéminent.

La place systématique de la nouvelle famille est un peu incertaine. La famille est peut-être voisine des Melanopsides, attendu que chez certains genres rapportés à cette famille, tels que *Faunus* Mtf. et *Morgania* Cossm. (= *Irania* Douvillé), on trouve des coquilles d'un galbe tout pareil à celui de *Faxia*, outre que le labre externe est encore ici muni d'un sinus pareil à celui de ce genre; mais une ouverture pareille à celle des individus adultes de *Faxia* est absolument inconnue chez les Melanopsides. Il est encore à noter que les espèces les plus anciennes des deux Melanopsides nommées ont été trouvées dans des dépôts daniens de la Perse. Il est donc en une certaine mesure vraisemblable que les Faxiides sont apparentées aux Melanopsides. — Chez les genres *Triforis* et *Triphora* on trouve, comme chez *Faxia*, trois ouvertures, mais l'ouverture principale diffère et la bande du sinus fait défaut chez ces formes. — Encore, M. le Prof. Dr. C.-M. Steenberg, qui a bien voulu examiner les matériaux de *Faxia*, a attiré mon attention sur une certaine ressemblance qu'a la *Faxia* avec quelques formes des *Potamidinae*, mais la construction de l'ouverture de ces formes diffère, et l'attribution de notre espèce à ce groupe me semble impossible.

Genre: Faxia n. gen.

Tant qu'on ne connaît qu'un seul genre de la famille le diagnostic du genre s'identifie essentiellement avec celui de la famille. On pourrait peut-être indiquer comme caractères spéciaux au genre que la spire est un peu obtuse et les tours presque plans; les tours relativement jeunes sont en outre distinctement étagés et leur surface lisse.

78. **Faxia macrostoma** n. sp.

Pl. VI, fig. 9 a—b, 10 a—b et 11.

Les détails donnés plus haut sur l'espèce en question sont à suppléer comme suit:

Coquille petite, rissoïdale, allongée. Protoconque courte, composée d'environ deux tours convexes, lisses. Tours suivants, au nombre d'environ huit, séparés par des sutures vaguement canaliculées; le tiers supérieur du tour excavé, occupé par la bande du sinus; le reste du tour un peu proéminent, aplati, à la fin s'abaissant abruptement du côté de la suture; la limite entre les deux parties assez aiguë. Surface lisse; des stries d'accroissement seules visibles, dessinant une faible courbe concave sur la partie supérieure du tour, se recourbant très fortement en avant à la limite de la partie inférieure, et se continuant de là en une faible courbe convexe jusqu'à la suture. Dernier tour un peu atténué du côté de l'ouverture circulaire; le bord de celle-ci fortement élargi et réfléchi comme décrit plus haut. Péristome continu, attaché au tour précédent en haut, atteignant presque la limite entre les deux zones du tour. A la face extérieure du pavillon un tout petit nombre d'épaississements parallèles au bord de l'ouverture. La base et le sinus du labre externe des jeunes individus décrits ci-dessus.

Hauteur, 6 mm; diamètre de l'avant-dernier tour, 2 mm; hauteur du dernier tour, 3 mm.

Pour trois seulement des coquilles adultes l'ouverture a été conservée; un certain nombre des autres coquilles conservent sur le tour précédent un reste de la partie antérieure du bord de l'ouverture. Les stries d'accroissement contournent l'ouverture anale, et également l'ouverture du canal. La bande approfondie sur le haut du tour fait défaut ou bien n'est que vaguement développée sur les tours les plus âgés.

Le »Nez«: 46 coquilles.

Famille: **Cerithiidae.**

Genre: Mathildia Semp. (1865).

79. **Mathildia unicarinata** n. sp.

Pl. IV, fig. 4 a—b.

Petite coquille turriculée. Protoconque basse, hétérostrophe. Tours suivants à carène spirale très forte, située un peu au-dessus de la suture inférieure, subconcaves au-dessus de la carène; la région au-dessous de celle-ci s'inclinant abruptement du côté de la suture. Tours ornés d'un nombre de cordons spiraux fins, dont deux situés respectivmement près de la suture supérieure et de l'inférieure. Les cordons spiraux croisés de costules transverses délicates, serrées, vaguement courbées. Base à peu près plane, à cordonnets spiraux délicats. L'ouverture, un peu endommagée, probablement subcirculaire; columelle excavée, sans plis.

Hauteur, 4 mm; diamètre, 2 mm; hauteur du dernier tour, 2 mm.

L'espèce est caractérisée surtout par les tours peu convexes et, en premier lieu, par la carène unique. L'espèce se distingue par là très facilement de *M. obtusa* v. Koen. de notre paléocène.

Le »Nez«: 1 coquille.

80. **Mathildia rosenkrantzi** n. sp.

Pl. IV, fig. 7 a—b.

Coquille petite, conique, à spire obtuse. Angle de la spire environ 36°; nombre de tours 5 à 6. La spire débutant par un tour lisse enroulé à peu près dans le même plan. Tours suivants peu convexes, séparés par des sutures très fortement déprimées; déjà au 2e tour deux cordons spiraux délicats, et bientôt après un troisième; encore plus tard un nombre de cordonnets spiraux plus faibles intercalés entre les trois cordons spiraux principaux; les cordons spiraux croisés de costules très nombreuses, serrées et délicates, étroites, presque lamelliformes, formant avec la suture supérieure un angle presque droit, vaguement courbées; aux intersections, des petits nœuds. Le dernier tour de la même hauteur que la spire, arrondi inférieurement du côté de la base. Base presque plane et ornée d'un nombre de cordons spiraux concentriques, dont le dernier délimitant la fente ombilicale profonde et assez grande comme un renflement marqué, non crénelé. Ouverture subquadrangulaire, à coins arrondis. Labre externe tranchant, courbé à angle arrondi; labre interne non calleux, un peu courbé en saillie sur la fente ombilicale. Péristome discontinu.

Hauteur, 4 mm; diamètre, 2,4 mm.

Notre espèce semble le plus voisine de *M. parva* Br. & C., mais cette dernière espèce possède e. a. 4 cordons spiraux uniformes.

Le »Nez«: 25 coquilles.

Genre: Bittium (Leach) Gray (1847).

81. **Cf. Bittium transenna** (Bayan).

Pl. III, fig. 14 a—b.

1824. *Cerithium clathratum* Deshayes, Descr. des Coq. foss. II. p. 357; pl. 53, fig. 22 à 25.
1864. — — —, Animaux sans vertèbres. III. p. 159.
1873. — *transenna* Bayan, Études sur coll. de l'École des Mines. II. p. 107.
1889. — — —; Cossmann, Cat. ill. des Coq. foss. IV. p. 41.

Une coquille un peu défectueuse est très voisine de cette espèce, pour la forme aussi bien que pour l'ornementation, mais l'ouverture n'étant pas conservée la détermination quant à l'espèce n'est pas tout à fait sûre.

Coquille petite, conique, allongée, à spire pointue. Protoconque assez obtuse, formée d'environ trois tours lisses, convexes. Tours suivants assez convexes, séparés par des sutures profondes. Ornementation consistant en cinq cordons spiraux équidistants, croisés de côtes transverses nombreuses, vaguement courbées, d'une grosseur à peu près égale à celle des cordons spiraux. La présence de varices pas sûrement constatée. Base excavée, couverte jusqu'au canal de cordons spiraux proportionnellement forts, granulés. Columelle excavée. Canal court.

Hauteur, 4,2 mm; diamètre, 1,3 mm.

Le »Nez«: 1 coquille.

Genre: Cerithium Bruguière (1789).

82. **Cerithium (Campanile?) pseudotelescopium** (M. U. H.), Ravn.

Pl. IV, fig. 8 a—b.

1902. *Cerithium pseudotelescopium* (M. U. H.), Ravn, Mollusk. i Danmarks Kridtafl. II. p. 219; pl. I, fig. 13 et 14.

Outre les matériaux recueillis auparavant on possède de cette espèce un petit nombre de débris à test conservé. Il ressort de ceux-ci qu'il n'y a que deux rangs de tubercules au-dessous de la suture. — Il est un peu douteux si le petit débris figuré à protoconque conservée se réfère à cette espèce. La protoconque est obtuse, courte, composée d'environ deux tours convexes, dont le diamètre s'agrandit rapidement. Sur les tours suivants se trouve une carène spirale un peu au-dessous du milieu du tour, et plus tard s'observent deux cordons spiraux immédiatement au-dessous de la suture; là-dessous le tour est faiblement excavé, et tout à fait en bas du tour se trouve un cordon spiral un peu plus fort. Les cordons spiraux sont croisés de côtes transverses nombreuses, un peu en biais, qui forment des nœuds sur les cordons spiraux.

Autrement les matériaux supplémentaires ne fournissent pas d'éclaircissements nouveaux sur la structure de la coquille. La forme de l'ouverture surtout est inconnue, ce n'est donc que sous toute réserve que l'espèce peut être rapportée au sous-genre *Campanile* Bayle.

Outre de nombreux moules internes, parfois avec moule externe correspondant, on possède (du »Nez«) quatre débris à test conservé.

83. **»Cerithium« fenestratum** Ravn.

1902. *Cerithium fenestratum* Ravn, Mollusk. i Danmarks Kridtafl. II. p. 222; pl. I, fig. 20 et 21.

On n'a pas recueilli de nouveaux matériaux de cette espèce. La forme de l'ouverture n'étant pas connue il n'est pas possible actuellement de rapporter l'espèce avec sûreté à l'un des nombreux genres dans lesquels, en temps moderne, on a divisé l'ancien genre *Cerithium*. Pour la forme et l'ornementation il rappelle certaines espèces du genre *Newtoniella,* mais la taille assez considérable rend difficile de le rapporter à ce genre. É. Vincent[1]) pense qu'il pourrait être un *Orthochetus* Cossm.

Le nom de l'espèce ayant été auparavant donné à plusieurs espèces dans le cadre de la famille des Cerithiidae, au sens large du mot, il est possible qu'il faudra appliquer un autre nom à l'espèce citée ici. Cette question ne pourra cependant pas être résolue avant qu'on possède de meilleurs matériaux, qui rendront possible de déterminer le genre avec sûreté.

Le petit nombre d'individus qu'on possède proviennent du Calcaire à Coralliaires.

84. »Cerithium« faxense Ravn.

1902. *Cerithium faxense* Ravn, Mollusk. i Danmarks Kridtafl. II. p. 223; pl. I. fig. 22.

Cette espèce n'a pas non plus été enrichie de matériaux nouveaux. Ici encore la détermination du genre est incertaine à cause de l'état défectueux des exemplaires présents.

Calcaire à Coralliaires: 4 coquilles.

Genre: Metacerithium Cossmann (1906).

85. Metacerithium? selandicum (M. U. H.), Ldgrn.

1847. *Cerithium selandicum* M. U. H., Amtl. Bericht Kiel. p. 118.
1866. — — — ; v. Fischer-Benzon, Ueb. d. rel. Alter des Faxek. p. 16.
1867. — — — ; Lundgren, Pal. Iaktt. p. 17; pl. 1, fig. 2.
1902. — — (—), Ldgrn.; Ravn, Mollusk. i Danmarks Kridtafl. II. p. 220; pl. I, fig. 15 et 16.
1926. — — Ldgrn.; Ødum, Daniet i Jyll. og paa Fyn. p. 186.

En fait de matériaux nouveaux cette espèce n'a été que peu augmentée. Un moule des tout derniers tours montre cependant que les tours finissent par être assez fortement imbriqués, et que les rangs de nœuds supérieurs disparaissent peu à peu, en premier lieu le second d'en haut. Le rang de nœuds immédiatement au-dessus de la suture inférieure, par contre, persiste et forme un bord élevé. La base n'est que peu convexe; elle porte de nombreuses stries concentriques, très délicates, un peu onduleuses, croisées de stries d'accroissement délicates, dirigées en avant.

La forme de l'ouverture n'étant pas connue la détermination du genre n'est pas sûre.

L'espèce a été trouvée dans le Calcaire à Bryozoaires aussi bien que dans le C. à Coralliaires, et elle est assez abondante.

Genre: Newtoniella Cossmann (1893).

86. Newtoniella angustisulcata n. sp.

Pl. V, fig. 1 a—b et 2 a—b.

Coquille très petite, conique allongée, à spire pointue et tours nombreux. Protoconque obtuse; son premier tour lisse; déjà au début du tour suivant un sillon spiral

[1]) É. Vincent: Moll. mont. du Poudingue etc. p. 33.

au-dessus de la suture inférieure, produisant le premier cordon spiral; sur les tours suivants encore deux sillons spiraux. Les tours suivants plans, séparés par des sutures presqu'invisibles; hauteur des tours un peu inférieure à la moitié de leur largeur; l'ornementation consistant en trois cordons spiraux assez marqués, séparés par des sutures étroites, le cordon supérieur souvent large, presque jusqu'au double de la largeur des autres. Sous une loupe très forte quelquefois traces de stries transverses extrêmement délicates. Dernier tour grand, à bord arrondi inférieurement. Base ornée d'une couple de cordons spiraux distincts. Ouverture quadrangulaire, à canal bien développé, fortement courbé; bord du labre externe épaissi. Columelle pourvue d'une carène assez tranchante, formée du bord supérieur du canal. Dans certains cas rares une varice sur les derniers tours.

L'exemplaire le mieux conservé (fig. 1 a—b) présente les mesures suivantes: Hauteur, environ 4 mm; diamètres du dernier et de l'avant-dernier tour, respectivement 1,4 et 1,1 mm; hauteur de l'ouverture, 0,8 mm.

L'ornementation des coquilles présentes est le plus voisine de celle du sous-genre *Seila* A. Adams, mais la protoconque et la forme du dernier tour et, surtout, du canal, militent plutôt en faveur de *Newtoniella s. s.* Cossmann (Paléoconch. comp. VII. p. 152) y rapporte une espéce douteuse de Maëstricht et une espèce du Montien belge. Ces deux espèces ont une ornementation bien différente de celle de notre espèce. La ressemblance avec certaines espèces de l'éocène français est beaucoup plus grande, mais pour celles-ci les cordons spiraux sont apparemment plus étroits, et les sutures qui les séparent, plus larges. *N.* (*Seila*) *tenuifila* (Br. & C.) s'en distingue e. a. par ses quatre cordons spiraux.

Le »Nez«: 160 coquilles.

87. **Newtoniella subglabra** n. sp.

Pl. V, fig. 5 a—b.

Un seul débris d'une coquille diffère de l'espèce précédente et pour la taille et pour l'ornementation et doit, par conséquent, être aussi d'une autre espèce.

Coquille relativement grand, conique allongée. Protoconque non conservée. Tours complètement plans, séparés par des sutures invisibles; sur la moitié inférieure du tour trois cordons spiraux délicats, serrés, faiblement bombés; la moitié supérieure du tour formée comme une bande unique, très large, faiblement bombée et un peu déprimée; en dehors de cela seulement des traces de stries spirales extrêmement fines et de stries d'accroissement. La base des tours limitée extérieurement par une arête assez tranchante, distinctement concave et extérieurement pourvue d'une couple de cordons spiraux. Le canal probablement assez court, fortement tordu, formant une carène tranchante sur la columelle. Ombilic faisant défaut.

Le débris en présence se compose d'environ six tours et justifie des mesures suivantes: hauteur, 5 mm; diamètres supérieur et inférieur, respectivement 2 et 2,5 mm.

Cette espèce diffère d'autres espèces surtout par son ornementation, d'après laquelle on pourrait être porté à la rapporter au genre *Trypanaxis* Cossm., mais elle ne possède aucune trace d'un ombilic.

Le »Nez«: 1 coquille.

88. **Newtoniella faxensis** n. sp.

Pl. IV, fig. 3 a—b et 9 a—b.

Coquille petite, conique. Protoconque composée de quatre à cinq tours convexes, couverts de petites côtes courbées. Tours suivants un peu convexes, distinctement étagés en avant; ornementation débutant par deux cordons spiraux, dont le supérieur placé au milieu du tour, l'inférieur immédiatement au-dessus de la suture inférieure; les tours encore plus jeunes presque complètement plans, ornés de deux nouveaux cordons spiraux, dont l'un tout en haut, l'autre situé entre les deux cordons primordiaux; de plus, des côtes transverses rectilignes, assez fortes, à distance relativement grande l'une de l'autre, au nombre de 15 à chaque tour, plus délicates et en un nombre un peu plus grand sur les tours les plus jeunes. Base excavée, circonscrite par une carène faible. Columelle tordue. Canal assez long, recourbé.

Un fragment figuré (fig. 9 a—b): hauteur, 4 mm; diamètre, 1,7 mm.

Cette espèce semble être assez voisine de *N. multispirata* (Desh.), trouvée dans l'éocène de Paris; elle s'en distingue par sa forme moins étroite et par le nombre de ses cordonnets spiraux.

Le »Nez«: 5 individus.

89. **Newtoniella fissicosta** n. sp.

Pl. IV, fig. 6 a—b et 10 a—b.

Coquille conique. Protoconque obtuse, comprenant trois tours lisses, convexes. Tours suivants faiblement concaves, séparés par des sutures indistinctes; ornementation composée de trois cordons spiraux assez tranchants, dont l'inférieur beaucoup plus fort que les autres et, presque dès le début, divisé au moyen de deux sillons spiraux délicats en trois cordonnets spiraux, dont celui du milieu le plus gros. Base faiblement concave, circonscrite par une carène arrondie.

L'un des deux fragments figurés (fig. 10 a—b) mesure 2,4 mm en hauteur et 0,8 mm en diamètre, l'autre (fig. 6 a—b), qui ne comprend que deux tours, 2 mm en diamètre.

Cette espèce se distingue, pour autant que je puisse voir, de toute autre espèce par la singulière tripartition du cordon spiral inférieur. Pour aucune des espèces décrites jusqu'ici je n'ai vu citer une telle division.

Le »Nez«: 3 coquilles.

Genre: Cerithiopsis Forbes & Hanley (1849).

90. **Cerithiopsis unisulcata** n. sp.

Pl. V, fig. 3 a—b et 4 a—b.

Coquille petite, conique allongée. Protoconque subulée, composée d'environ 5 tours très convexes, dont les trois premiers lisses, les suivants ornés de côtes transverses obliques. Les tours subséquents, au nombre d'environ 14, lisses, séparés par des sutures indistinctes; ornementation formée de tubercules, rangés en deux séries spirales ayant entr'elles un sillon excavé assez large; les tubercules, au nombre d'environ 20 sur chacun des tours les plus jeunes, allongés longitudinairement par rapport à la coquille, mais un peu obliques, croisés de quelques cordonnets spiraux élevés, très délicats, particulièrement distincts dans les intervalles entre les tubercules; la distance entre les deux séries spirales s'accroissant sur les tours les plus jeunes, et les tubercules, surtout ceux de la série supérieure, quelquefois se fondant l'un dans l'autre. Dernier tour à bord tranchant du côté de la base vaguement convexe, ornée de cordonnets spiraux extrêmement délicats, très indistincts. Ouverture quadrangulaire, à canal court, un peu replié.

Un des fragments figurés (fig. 3 a—b), qui a 4 mm de haut, se compose des 8 tours les plus jeunes; il a, en haut, un diamètre de 0,8 mm et, en bas, de 1,2 mm; hauteur du dernier tour, 0,8 mm. Un certain nombre de coquilles auront été un peu plus grandes.

L'espèce décrite ici se rapproche beaucoup de *C. bimonilifera* (Sandb.), trouvée dans l'oligocène moyen et inférieur de l'Allemagne. Les tubercules de notre espèce sont pourtant obliques et souvent un peu plus allongés.

Le »Nez«: 55 coquilles.

91. **Cerithiopsis trinodosa** n. sp.

Pl. IV, fig. 5 a—b.

Un fragment unique possède une ornementation assez singulière et semble se référer à une espèce non décrite jusqu'ici.

Coquille conique allongée. La protoconque fait défaut. Tours plans, sans sutures distinctes, ornés de 15 côtes transverses délicates, un peu obliques, croisées de trois cordonnets spiraux d'une force à peu près égale à celle des côtes; aux points d'intersection, des tubercules assez délicats, un peu allongés; la distance entre la série de tubercules supérieure et la médiane beaucoup inférieure à celle entre la série inférieure et la médiane, ces deux dernières séparées par un sillon profondément excavé. Les côtes transverses s'anéantissant sur les tours les plus jeunes. Base délimitée extérieurement par une arête assez tranchante; immédiatement en dedans de celle-ci un cordon spiral fort et élevé; autrement base plate et lisse. Ouverture pas conservée; canal probablement court et un peu courbé.

Le fragment, composé d'environ 7 tours, mesure 5,5 mm en hauteur, et en diamètre 1,9 mm et 1,1 mm, respectivement en bas et en haut.

Quelques fragments, partiellement assez mal conservés, possèdent également des côtes transverses délicates, croisées de trois cordonnets spiraux formant des tubercules, mais ils semblent placés à distance égale. C'est pourquoi on ne pourra probablement pas les rapporter sûrement à l'espèce décrite ici.

Cette espèce semble très voisine de *C. alveolata* (Desh.); celle-ci ne possède cependant pas le profond sillon entre la série de tubercules médiane et l'inférieure; de plus, ses tubercules se rapprochent d'avantage de la forme circulaire.

Le »Nez«: 1 (+ 6?) coquille.

92. **Cerithiopsis faxensis** n. sp.

Pl. V, fig. 6 a—b, 7 a—b et 8 a—b.

Coquille assez petite, conique. Protoconque à nucléus oblique, et à peu près quatre tours convexes, saillants vers le bas, à côtes transverses assez délicates, obliques. Tours suivants peu convexes, séparés par des sutures distinctes, un peu déprimées et fortement ondulées, ornés de quatre (sur les tours relativement jeunes, cinq à six) cordons spiraux assez forts, dont le plus supérieur immédiatement auprès de la suture et séparé du suivant par un sillon spiral relativement profond; de plus, de fortes côtes transverses, un peu obliques, au nombre de 17 à 18, croisées des cordons spiraux, et en largeur un peu inférieures à leurs intervalles; pas de tubercules distincts aux points d'intersection; les côtes transverses peu à peu plus délicates sur les tours jeunes. Dernier tour délimité vers la base par un bord assez tranchant. Base plate, lisse ou ornée de cordonnets spiraux très délicats. Ouverture quadrangulaire, nettement séparé du canal court, fortement recourbé et délimité supérieurement par une carène tranchante.

L'ornementation peut varier en une certaine mesure, et les tours sont quelquefois assez plats, mais ces formes un peu divergeantes se rattachent par des formes transitoires à la forme typique.

Un fragment (fig. 7 a—b) présente les mesures suivantes: hauteur, 10,2, diamètre au bout supérieur, 0,6, et au bout inférieur, 3,0 mm; hauteur du dernier tour (y compris le canal), 3,0 mm.

Parmi les espèces décrites auparavant certaines variétés de *C. saxonicum* v. Koen. de l'oligocène inférieur allemand se rapprochent le plus de notre espèce; mais ladite espèce semble e. a. être dépourvue du profond sillon caractéristique au-dessous du cordonnet spiral supérieur. *C. trigeminatum* (Desh.) ne possède pas non plus ce sillon et, à côté de cela, il n'a que trois cordonnets spiraux et ses tours sont plus aplatis.

Le »Nez«: 121 coquilles.

93. **Cerithiopsis brünnichi** n. sp.

Pl. IV, fig. 14 a—b et 15 a—b.

Coquille petite, turriculée allongée. Protoconque obtuse, formée de quatre à cinq tours bombés, lisses, dont les trois premiers s'accroissant rapidement en diamètre. Tours suivants assez faiblement convexes et séparés par des sutures canaliculées, ornés de deux cordons spiraux forts, divisant le tour en trois régions, dont l'inférieure un peu plus étroite que les autres et plus inclinée que la supérieure; immédiatement auprès de la suture supérieure et l'inférieure, un cordonnet spiral délicat; pour cette raison la suture canaliculée. Sur le dernier tour une arête formée du cordonnet spiral inférieur, délimitant la base plane ou vaguement concave, extérieurement ornée d'un seul cordonnet spiral assez peu distinct. L'ornementation des tours suppléée en outre d'environ 17 côtes transverses un peu obliques, de la même grosseur que les deux cordons spiraux du milieu; les points d'intersection formant des nœuds. Ouverture rectangulaire arrondie, à canal court, un peu recourbé.

On ne possède que des fragments de cette espèce. Le fragment le moins incomplet est haut de 5,6 mm et large de 0,7 et 1,7 mm, respectivement en haut et en bas; hauteur du dernier tour (y compris le canal), 1,7 mm.

Cette espèce est très voisine de *C. maresi* (Desh.), qui est moins allongée, cependant, et possède de forts cordons spiraux sur la base.

Le »Nez«: 4 coquilles.

94. **Cerithiopsis jenseni** n. sp.[1])

Pl. IV, fig. 11 a—b.

Coquille petite, conique allongée. Protoconque obtuse, composée d'environ trois tours fortement convexes, bientôt couverts de côtes transverses fines. Les tours suivants assez convexes, séparés par des sutures distinctes et ornés de quatre cordons spiraux à peu près équidistants, dont les deux du milieu un peu plus gros que les autres; en outre, un cordonnet spiral très délicat tout à fait au bas du tour; de plus, de nombreuses côtes transverses assez serrées, formant des nœuds à l'intersection des cordons spiraux. Dernier tour fortement arrondi du côté de la base vaguement concave, ornée vers la périphérie de deux cordonnets spiraux assez fins. Cou très court. Ouverture quadrangulaire-ovale, à canal court, tourné vers la gauche. Labre externe mince, presque rectiligne. Columelle droite, lisse.

Hauteur (de l'individu le plus grand), 6 mm; diamètre, 2 mm; hauteur du dernier tour, 2,3 mm.

L'ornementation surtout fait penser à *Semibittium* Cossm., sous-genre du genre *Bittium*, mais le canal bien développé, e. a., et la base presque lisse font hésiter à rapporter l'espèce à ce genre. L'espèce se distingue de *C. brünnichi* n. sp. décrite plus haut e. a. par son galbe moins élancé et par le nombre plus grand de cordons spiraux; la protoconque aussi diffère passablement. L'espèce est apparemment plus voisine de *C. bernayi* Cossm., qui, d'après la description de Cossmann, possède une protoconque pareille; mais cette espèce est fortement étagée et n'a que trois cordons spiraux; ajoutez-y que ses nœuds ne sont pas aussi arrondis.

Le »Nez«: 7 coquilles.

95. **Cerithiopsis selandica** n. sp.

Pl. V, fig. 9 a—b et 10 a—b.

Coquille petite, conique allongée. Protoconque aiguë, composée de cinq à six tours convexes, les premiers lisses, le dernier finement costulé. Tours de spire sub-

[1]) J'ai dédié cette espèce au maître fouilleur P. Jensen, à Faxe, qui a recueilli des fossiles du Calcaire de Faxe pendant bien des années et qui a fait don à notre Muséum d'un certain nombre d'exemplaires rares.

convexes, séparés par des sutures assez distinctes et ornés de deux cordonnets, croisés de côtes axiales fortes, au nombre de 12 par tour; aux points d'intersection des nœuds arrondis. Outre cela, deux cordonnets très délicats, un peu tuberculés, placés audessus et au-dessous de la suture. Tour dernier court; base un peu excavée, lisse, circonscrite par une carène. Ouverture quadrangulaire; canal court, tordu.

Hauteur, 2,4 mm; diamètre, 0,7 mm.

Cette espèce est assez voisine de *C. diozodes* Cossm. de l'éocène français, mais elle est e. a. plus courte et ses tours sont distinctement convexes.

Le »Nez«: 6 coquilles.

96. **Cerithiopsis tricingulata** n. sp.

Pl. V, fig. 11 a—b.

Coquille très petite, turriculée. Protoconque élevée, composée de 6 tours convexes, les premiers lisses et s'accroissant rapidement en diamètre, les suivants à costules transverses très fines et une ornementation spirale naissante. Tours suivants plans, séparés par des sutures indistinctes, et ornés de trois cordons spiraux, dont l'inférieur quelquefois plus large que les deux autres. Base excavée, lisse. Canal court(?).

Dimensions du fragment le plus complet: hauteur, 2,5 mm; diamètre, 0,5 mm.

De cette espèce on ne connaît qu'une couple de fragments, tous deux à protoconque conservée. L'ornementation est tout à fait égale à celle du genre *Newtoniella* (surtout celle du sous-genre *Seila*), et à cet égard l'espèce ressemble beaucoup à *N. angustisulcata* n. sp. décrite auparavant, mais la protoconque en est tout autre, attendu qu'elle correspond à celle du genre *Cerithiopsis*.

Le »Nez«: 2 coquilles.

97. **Cerithiopsis obliquecostulata** n. sp.

Pl. IV, fig. 12 a—b et 13 a—b.

Coquille très petite, conique allongée. Protoconque composée de 6 à 7 tours assez fortement convexes, à costules axiales nombreuses, très fines, un peu courbées; les trois premiers tours augmentant leur diamètre rapidement, les suivants très lentement. Tours suivants subconvexes, séparés par des sutures distinctes; ornementation composée de côtes transverses très obliques, augmentant en grosseur du côté de la suture inférieure, et se terminant en un petit nœud, au nombre de 13 à 14 pour chaque tour; outre cela, une couple de cordonnets spiraux indistincts, dont l'inférieur est le plus gros. Base plate et lisse, circonscrite d'une arête un peu arrondie. Ouverture probablement quadrangulaire; canal étroit, court et tourné vers la gauche.

Un fragment (fig. 13 a—b) composé de la protoconque et des trois tours suivants, mesure 2 mm de hauteur et 0,6 mm de diamètre. Pour un autre fragment (fig. 12 a—b), composé d'à peu près 8 tours, la hauteur est de 2,8 mm et le diamètre depuis 0,7 jusqu'à 1 mm.

Cette espèce se distingue d'autres espèces par les côtes obliques caractéristiques.

Le »Nez«: 6 coquilles.

Genre: Trypanaxis COSSMANN (1889).

98. **Trypanaxis? faxensis** n. sp.

Pl. V, fig. 18 a—b.

Coquille petite, conique. Tours plans, séparés par des sutures distinctes et ornés de quatre sillons spiraux délicats, dont le second d'en haut le plus distinct; en outre, des costules transverses serrées, très délicates, le plus distinctes sur les tours les plus âgés et s'anéantissant sur les plus jeunes. Dernier tour uniformément arrondi vers la base convexe et ornée d'un certain nombre de cordonnets spiraux délicats. Ouverture quadrangulaire arrondie, munie d'une rainure vers le haut et nettement séparée du canal court mais distinct et un peu recourbé. Labre externe vaguement courbé; bord columellaire dégagé de la base et recourbé.

La coquille décrite ici est un fragment où la protoconque et les premiers tours subséquents font défaut. Sa hauteur est de 5,6 mm et le diamètre depuis 0,9 jusqu'à 1,8 mm; hauteur du dernier tour (y compris le canal), 2,3 m. Des fragments de coquilles plus grandes possèdent un plus grand nombre de cordonnets spiraux, mais correspondent autrement très bien à la description précédente.

La détermination du genre est un peu douteuse. Ce qui fait hésiter à la rapporter au genre *Trypanaxis* est notamment le canal, court, il est vrai, mais pourtant distinct. Il n'y a pas de fente ombilicale. Sous ce rapport l'espèce correspond à des formes telles que *T. imperforata* (DESH.), qui est censée, pourtant, avoir une fente rudimentaire. Pour l'ornementation l'espèce rappelle *T. hypermeces* COSSM., mais cette espèce est munie de 6 à 7 cordonnets spiraux et un canal plus court, outre qu'elle n'est que faiblement perforée. *Tr. umbilicata* (LAMK.) possède une ornementation pareille à celle de notre espèce, mais son ombilic est distinct.

Le »Nez«: 8 coquilles.

Genre: Triforis DESHAYES (1834).

99. **Triforis (Epetrium) cretacea** n. sp.

Pl. V, fig. 12 a—b et 13 a—b.

Petite coquille sénestre, conique allongée, à spire pointue, subulée. Protoconque composée d'environ trois tours lisses, convexes; les 2 à 3 tours subséquents également convexes et munis de deux cordons spiraux élevés. Les tours suivants, au nombre d'environ 10, plans, séparés par des sutures assez indistinctes, et ornés de deux rangs de cordons spiraux, composés de tubercules subcirculaires, de grosseur à peu près égale, un peu obliques; immédiatement au-dessous de la suture souvent un troisième rang de tubercules bien plus petits; sur les tours les plus jeunes le nombre de tubercules d'environ 20 pour chaque cordon. Dernier tour à base subconvexe, ornée de quelques cordonnets spiraux délicats, élevés. Ouverture assez petite, quadrangulaire à angles arrondis. Canal clos, tubulaire, un peu recourbé, obtus; labre externe muni supérieurement d'un tube réfléchi obliquement; bord columellaire dégagé, précédé d'une petite fente.

Hauteur, environ 6 mm; hauteur du dernier tour (y compris le canal) et diamètre, 1,3 et 1,5 mm.

Cette espèce se distingue de toutes les autres espèces munies de trois rangs de tubercules que je connaisse, e. a. par le fait que le rang supérieur est composé de tubercules beaucoup moins gros que les tubercules des deux autres rangs. — Chez *Tr. herouvalensis* le Reine c'est le rang de tubercules du milieu qui est le plus faible. — Chez *Tr. grignonensis* Desh. aussi bien que chez *Tr. minuta* Desh. tous les trois rangs de tubercules sont à peu près d'égale grosseur outre que la suture est assez fortement déprimée.

Le »Nez«: 76 coquilles.

100. **Triforis (Epetrium) crassigranulata** n. sp.

Pl. VI, fig. 1 a—b et 2 a—b.

Quelques fragments plus ou moins défectueux sont à référer à une nouvelle espèce, qui se sépare un peu de la précédente.

Coquille sénestre, proportionnellement assez grande, conique. Protoconque pareille à celle de l'espèce précédente. Les tours suivants, au nombre d'environ 15, plans, séparés par des sutures indistinctes, et ornés de deux rangs de cordons spiraux composés de tubercules arrondis, relativement gros, s'élévant, sur les tours les plus jeunes, à un nombre de 12 à 14 pour chaque rang; les tubercules des deux rangs le plus souvent non correspondants; quelquefois un troisième rang de tubercules beaucoup plus petits immédiatement au-dessous de la suture. Dernier tour à base assez nettement délimitée, vaguement convexe, munie de plusieurs cordons spiraux élevés. Ouverture assez petite, quadrangulaire arrondie. Canal clos, tubulaire, rétroverse, obtus. Bord columellaire dégagé, précédé d'une fente assez large. Labre externe muni d'un tube saillant, montant un peu obliquement.

Dimensions d'un des exemplaires les plus complets: Hauteur, environ 11 mm; diamètre et hauteur (y compris le canal) du dernier tour, 2 mm.

Cette espèce se distingue de la précédente par le fait que le nombre des tubercules est un peu inférieur, mais les tubercules en eux-mêmes plus gros et plus circulaires. A ma connaissance, cette espèce se rapproche probablement le plus de *Tr. bigranosa* de l'oligocène inférieur de Lattorf, décrite par v. Koenen; chez cette espèce se trouve, cependant, un cordon spiral étroit, élevé, entre les deux rangs de tubercules. *Tr. tricornuta* Cossm. et Pis. est moins allongée, et les deux rangs spiraux des tubercules sont plus rapprochés des sutures, ce qui fait que l'intervalle entre les deux rangs est plus grand que chez notre espèce.

Le »Nez«: 14 coquilles.

101. **Triforis (Epetrium) separabilis** n. sp.

Pl. V, fig. 17 a—b.

Un fragment d'une *Triforis* diffère pour l'ornementation des espèces décrites ci-dessus, et elle ne peut donc être rapportée ni à l'une ni à l'autre de celles-ci.

Coquille petite, turriculée, sénestre. Tours plans, séparés par des sutures assez distinctes, un peu sinueuses, et ornés de quatre rangs de cordons spiraux composés de tubercules arrondis; le rang supérieur immédiatement au-dessous de la suture; l'inférieur auprès de la suture inférieure; grosseur des tubercules s'accroissant du premier au troisième rang, celle du rang inférieur beaucoup plus petite que celle des autres rangs; les tubercules des quatre rangs non correspondants. Base faiblement convexe, nettement délimitée vers le haut, et munie de quelques cordons spiraux décroissant en grosseur du côté du canal. Canal probablement réfléchi.

Le fragment, composé des cinq tours les plus jeunes, a 6,3 mm de hauteur; diamètre du dernier tour, 2,2 mm.

C'est notamment la présence de quatre rangs de nœuds qui caractérise cette espèce, par où elle se distingue facilement e. a. des autres espèces de Faxe.

Le »Nez«: 1 coquille.

Genre: Triphora Blainville (1828).

102. **Triphora (Ogivia) faxensis** n. sp.

Pl. V, fig. 14 a—b.

De cette espèce on possède seulement un fragment, composé des trois derniers tours, à peu près. L'espèce est facilement reconnaissable, cependant, a cause de son ornementation particulière.

Coquille petite, sénestre, probablement conique allongée. Tours plans, séparés par des sutures distinctes, un peu sinuées, et ornés de 14 côtes transverses relativement larges, un peu obliques, croisées un peu au-dessous du milieu du tour d'un sillon spiral large, excavé, et, tout près de la suture supérieure, d'un autre sillon spiral beaucoup plus étroit, assez indistinct; chacune des côtes divisée ainsi en trois tubercules, dont celui du milieu le plus gros, le supérieur très faible et indistinct. Dernier tour subconvexe, à côtes transverses s'anéantissant assez subitement du côté du canal, entrecoupées de nombreux sillons spiraux; ceux-ci décroissant peu à peu du côté du canal, mais pourtant encore visibles sur le canal. Ouverture rhomboïdale arrondie, nettement délimitée du canal ouvert et fortement courbé. Labre externe muni en haut d'un tube court(?), montant un peu obliquement. La partie inférieure de la columelle un peu tordue, sans pli.

Hauteur de l'avant-dernier tour, 0,8 mm, son diamètre, 1,9 mm; hauteur du dernier tour (y compris le canal), environ 2,5 mm.

Cette espèce ressemble beaucoup à *Tr. singularis* (Desh.), mais chez celle-ci le rang de tubercules moyen est de beaucoup le plus faible.

Le »Nez«: 1 coquille.

103. **Triphora (Oğivia?)** sp.

Un fragment unique d'une *Triphora* est trop incomplet pour être déterminé de plus près, mais son ornementation diffère considérablement de celle de l'espèce précédente. Ainsi les tours sont faiblement convexes et sont couverts de quatre cordons spiraux élevés, qui sont tous granuleux; les tubercules du second cordon d'en bas sont assez gros et un peu obliques, ceux du second cordon d'en haut sont un peu plus faibles, et ceux du cordon supérieur sont encore plus faibles; les tubercules de ces trois cordons correspondent et constituent des rangs de travers obliques; le cordon spiral inférieur se trouve immédiatement auprès de la suture, et ses tubercules sont faibles, étroits, très allongés, et ne correspondent pas exactement aux tubercules des autres cordons spiraux.

Le »Nez«: 1 fragment.

Famille: **Cypraeidae.**

Dernièrement M. F. A. Schilder, qui s'est voué spécialement à l'étude des Cypraeides récentes et fossiles, a étudié les formes trouvées dans le Calcaire de Faxe, et il a réussi — partiellement au moyen de méthodes statistiques appliquées aux variations — à augmenter assez considérablement le nombre d'espèces connues. Malheureusement il n'est pas toujours facile, surtout lorsqu'on a affaire seulement à des moules, de distinguer entre ces espèces différentes. Pour les espèces suivantes je me suis pourtant conformé aux points de vue de M. Schilder, et je me borne ici à renvoyer à son travail[1]). Exception est faite pour une seule espèce, dont on a maintenant trouvé un certain nombre de jeunes individus; pour cette espèce j'ajoute des informations supplémentaires.

Genre: Cypraea Linné (1758).

104. **Cypraea (Cypraedia) separabilis** Schild.

1928. *Cypraedia separabilis* Schilder, l. c. p. 9; fig. 6.

105. **Cypraea (Cypraedia) ravni** Schild.

1928. *Cypraedia Ravni* Schilder, l. c. p. 11; fig. 7.

106. **Cypraea (Eocypraea) danica** Schild.

1928. *Eocypraea danica* Schilder, l. c. p. 12; fig. 1, 2 et 11.

107. **Cypraea (Eocypraea) bullaria** (v. Schloth.).

1928. *Eocypraea bullaria* Schloth.; Schilder, l. c. p. 14; fig. 8 à 10.

[1]) F. A. Schilder: Die Cypraeacea des Daniums von Dänemark und Schonen. — Danmarks geol. Undersøg. IV. R. Bd. 2. Kbhvn. 1928.

108. **Cypraea (Vicetia) faxensis** Schild.

1928. *Vicetia faxensis* Schilder, l. c. p. 17; fig. 19.

109. **Cypraea (Palaeocypraea) spirata** (v. Schloth.).

Pl. VI, fig. 4 a—b et 5 a—b.

1928. *Palaeocypraea spirata* Schloth.; Schilder, l. c. p. 19; fig. 3—5 et 12—14.

Dans le »Nez« on a trouvé quelques coquilles de jeunes individus, qui sont à rapporter à cette espèce. Un certain nombre d'entre elles sont très bien conservées, à protoconque intacte. Nous ferons ici la description d'une telle coquille (fig. 5 a—b), tout en renvoyant, du reste, au travail cité de M. Schilder.

Coquille buccinoïde, composée d'à peine deux tours outre la protoconque. Hauteur, 4 mm; diamètre, 2,4 mm; hauteur de l'ouverture, 3 mm. Spire pointue, débutant par un petit nucléus lisse composé d'environ $1^1/_2$ tour, suivi de $2^1/_4$ tours convexes ornés de deux systèmes de costules extrêmement délicates, obliques, un peu courbées, s'entrecroisant sous un angle d'environ 75°; aux points d'intersection un tout petit nœud. Protoconque terminée par une varice. Tours suivants assez plans, séparés par des sutures indistinctes, et couverts de costules axiales très délicates, un peu rétroverses en bas, et croisées de fines costules spirales; nombre de celles-ci trois au début, dont celle du milieu la plus grosse et constituant une petite carène un peu au-dessus du milieu du tour; leur nombre grossissant plus tard, et leur grosseur et leurs intervalles un peu variables. Hauteur du dernier tour à peu près égale aux six septièmes de la hauteur totale de la coquille; l'ornementation de ce tour pareille à celle du reste de la coquille, seulement plus ravalée. Ouverture ovale, supérieurement en pointe et inférieurement avec trace d'un canal court. Labre externe mince et tranchant, sans plis intérieurs; bord columellaire pas nettement délimité. Columelle tortillée vers le bas, sans dents ni plis.

Un certain nombre de coquilles un peu plus grandes (fig. 4 a—b) dont la protoconque et les tours subséquents possèdent l'ornementation décrite ci-dessus, nous font voir qu'à partir du début, environ, du troisième tour (non compris la protoconque) le tour commence de s'allonger du côté de la pointe de la spire; nous avons ici des coquilles intermédiaires entre la forme jeune décrite ci-dessus et la coquille tout à fait adulte.

Le fait que ces coquilles sont rapportées ici à *C. spirata* est dû à leur ornementation et leur galbe, qui semble correspondre à un moule de coquille adulte décrit auparavant par moi, et aussi à un individu à test conservé trouvé plus tard; la protoconque est cependant moins bien conservée pour ces deux exemplaires. Il est vrai que la possibilité existe qu'une partie des jeunes coquilles en présence aura pu appartenir à *C. suecica* Schild., sûrement très voisine de l'autre, et dont l'ornementation n'est pas connue, mais d'après M. Schilder cette espèce n'a pas été trouvée dans le »Nez«.

Le »Nez«: 23 jeunes individus. En dehors de cela (d'après l'énumération de Schilder), environ 300 individus adultes, dont une partie ont été également trouvés dans le »Nez«.

110. **Cypraea (Palaeocypraea) suecica** Schild.

1928. *Palaeocypraea suecica* Schilder, l. c. p. 22; fig. 16 à 18.

111. **Cypraea (Protocypraea) globuliformis** Ravn.

1928. *Protocypraea globuliformis* Ravn; Schilder, l. c. p. 23; fig. 15.

Famille: **Tritoniidae.**

Genre: Tritonium Link (1807).

112. **Tritonium (Sassia) faxense** n. nom.

Pl. V, fig. 16 a—b; pl. VI, fig. 7 a—b.

1902. *Tritonium fenestratum* Ravn, Mollusk. i Danmarks Kridtafl. II. p. 227; pl. II, fig. 7 et 8.

Le nom de *Tr. fenestratum* ayant déjà en 1878 été donné par G. Vincent à une espèce de l'éocène belge, il a été nécessaire d'adopter un autre nom pour notre espèce.

Dans le »Nez« on a trouvé un nombre de très petites coquilles qui sont apparemment des jeunes exemplaires de cette espèce. Elles sont très bien conservées, et on peut les décrire ainsi:

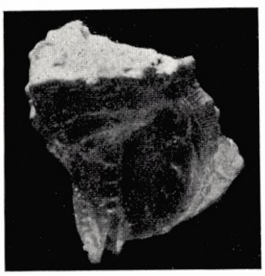

Fig. 3.

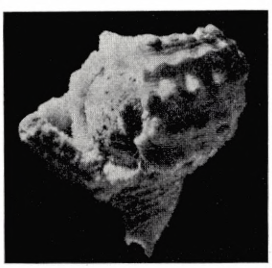

Fig. 4.

Fig. 3—4. *Tritonium (Sassia) faxense* n. nom. $^2/_1$.

Forme trapue. Protoconque composée d'un nucléus déprimé et trois tours lisses, convexes; sur le dernier demi-tour, cependant, des cordonnets spiraux délicats. Le reste de la coquille composé de $^1/_2$ à 1 tour, par son ornementation assez nettement distinct de la protoconque. Cette ornementation composée de fortes côtes transverses, larges et assez aplaties, s'évanouissant rapidement du côté de la base et croisées de gros cordons spiraux alternant avec des cordonnets beaucoup plus délicats. Les points d'intersection formant des tubercules. Dernier tour en pente abrupte vers le canal. Base couverte de cordonnets spiraux variant en grosseur mais toujours un peu plus faibles que les cordons spiraux de la partie supérieure du tour. Ouverture largement ovale, à canal court, nettement limité, faiblement courbé. Labre externe perpendiculaire, à bord fortement épaissi sous la forme d'une varice, et à grosses dents à l'intérieur. Bord columellaire apparemment lisse en général, mais sur de rares coquilles 2 à 3 plis ou dents faibles, presque horizontales.

Hauteur de la coquille figurée (fig. 7 a—b), 3,8 mm; diamètre, 2,7 mm; hauteur de l'ouverture (canal compris), 2,3 mm.

Que les petites coquilles décrites ici aient appartenu à *Tr. faxense* ressort de quelques coquilles un peu plus grandes, où soit la protoconque, soit une couple des tours suivants, sont conservés. Sur une de ces coquilles on voit e. a. les dents du côté inférieur du bord columellaire.

A ma description antérieure des exemplaires adultes est à ajouter que sur un des exemplaires figurés (l. c. fig. 8) on voit, outre les trois plis ou dents du bord columellaire cités, des traces d'encore 3 ou 4 plus bas du côté du canal. Un fragment trouvé par M. le médecin-major, Dr. K. Brünnich Nielsen (ci-contre fig. 3—4), et dont l'ouverture est très bien conservée, révèle aussi nettement ces dents. On voit ici également que le canal est très étroit et fortement réfléchi en dehors.

Calcaires à Coralliaires et à Bryozoaires: 59 coquilles, dont la plupart du Calcaire Coralliaire; sur ce nombre, 19 provenant du »Nez«.

113. **Tritonium (Lampusia?) subglabrum** Ravn.

Pl. V, fig. 15.

(Voir 1902. *Tritonium subglabrum* Ravn, Mollusk. i Danmarks Kridtafl. II. p. 228; pl. II, fig. 9 et 10).

Dans le »Nez«, on a trouvé le bout d'une couple de coquilles, dont l'un surtout présente une protoconque très bien conservée.

Spire effilée. Nucléus très petit, pas proéminent; tours suivants très convexes et complètement lisses; déjà sur le second tour, pourtant, une couple de cordonnets spiraux délicats, augmentant peu à peu en grosseur et en nombre; au bout de $3^1/_2$ tours, la première varice.

Un exemplaire plus grand à test conservé révèle que la coquille tout entière a été couverte de cordonnets spiraux très délicats, croisés par endroits de plis transverses extrêmement délicats, émoussés; à intervalles inégaux se trouvent des varices très marquées.

Calcaires à Coralliaires et à Bryozoaires: 23 coquilles.

114. **Tritonium sp.**

(Voir 1902. *Tritonium* sp. Ravn, Mollusk. i Danmarks Kridtafl. II. p. 229).

On n'a pas trouvé de matériaux supplémentaires, de sorte qu'il est impossible encore de faire une détermination plus précise.

Calcaire à Coralliaires: 4 coquilles.

Genre: Ranella Lamarck (1812).

115. **Ranella faxensis** n. sp.

Pl. VI, fig. 6 a—b.

Une très petite coquille, malheureusement un peu fragmentaire, aura sans aucun doute appartenu à un jeune individu d'une espèce de *Ranella*.

Coquille fusiforme. Protoconque papillaire, naticoïde, composée d'un peu plus de deux tours lisses, convexes. Tours suivants à région plane au-dessous de la suture, ornés d'abord de trois cordons spiraux étroits, ensuite d'un plus grand nombre, et de côtes transverses faibles, assez larges, s'éteignant peu à peu; de plus, de fortes varices rangées en deux séries diamétralement opposées. Dernier tour grand; base excavée sous le cou, à cordons spiraux assez peu nombreux. Ouverture pas complètement conservée; labre externe épaissi; bord columellaire nettement limité. Canal proportionnellement long, vaguement courbé.

Hauteur, 3,9 mm; diamètre, 1,8 mm.

Avant qu'on ne possède de plus grands individus il sera impossible de faire des comparaisons avec des espèces décrites auparavant. Pourtant j'ai trouvé pratique d'appliquer un nom à l'espèce, nom qui serait évidemment aboli si l'on arrivait à constater l'identité de l'espèce avec une espèce décrite antérieurement.

Le »Nez«: 1 coquille.

Famille: **Columbellidae.**

Genre: **Johnstrupia** n. gen.[1])

Test épais. Taille assez petite. Forme courte, rhomboïdale. Spire très courte, conique, recouverte par un enduit épais de vernis; sutures invisibles; tours peu nombreux, convexes; dernier tour à peu près égal à la hauteur totale, ventru, atténué en bas. Ouverture allongée, sinueuse, étroite, pas échancrée en haut, terminée en bas par un canal court et distinct, transversalement tronqué à son extrémité par une échancrure peu profonde. Labre externe obliquement incliné, fortement épaissi et denticulé à l'intérieur, aplati dans le plan de l'ouverture, sa partie médiane étant le plus épaissie et le plus aplatie. Bord columellaire arqué, muni de dents sur toute sa hauteur; celles de la columelle courtes et placées sur un aplatissement, les autres allongées; columelle formant un angle distinct avec le bord columellaire supérieur; au-dedans des dents mentionnées encore une ou deux dents nodiformes à l'intérieur de la columelle.

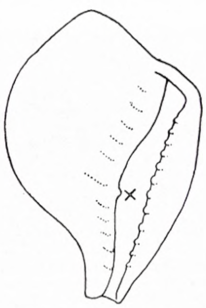

Fig. 5. *Johnstrupia faxensis* n. gen. et n. sp. $^4/_1$. × indique la situation d'une dent intérieure.

J'ai hésité quelque peu pour la question à savoir à quelle famille le genre décrit ici devrait être rapporté, et à ce propos j'ai consulté des collègues tant dans la patrie qu'à l'étranger. Leurs idées là-dessus ont différé passablement. Toutefois je suis très obligé à M. le professeur, Dr. C.-M. Steenberg pour avoir attiré mon attention sur certaines particularités caractérisant le genre, d'après lesquelles il sera bien fondé de le rapporter aux Columbellides. Ces particularités sont les suivantes: 1) l'angle distinct entre la columelle et le bord columellaire supérieur; 2) la columelle aplatie; 3) la forme des dents: les dents de la columelle sont assez petites et serrées; les dents du bord columellaire supérieur sont d'un caractère tout différent et sont à considérer comme un phénomène secondaire, connu également d'ailleurs; 4) la présence de dents à l'intérieur de la columelle; 5) la forte inclinaison par le haut du labre externe;

[1]) J'ai dédié ce genre à la mémoire de mon ancien maître Fr. Johnstrup, de 1866 à 1894 professeur de minéralogie à l'Université de Copenhague, qui, le premier, a fourni une description détaillée du Calcaire de Faxe (1864).

6) les dents du labre externe sont courtes et ne se trouvent que sur le bord-même du labre; 7) la présence d'un canal distinctement limité. Tous ces caractères rendent impossible d'identifier le genre à *Erato*, avec lequel il a une grande ressemblance quant à l'habitus, mais ils se retrouvent presque chez toutes les columbellides. Notre genre se distingue cependant des genres de cette famille connus jusqu'ici surtout par le canal relativement long et nettement limité et par les longues dents du haut du bord columellaire. Pour cette raison le professeur Steenberg est d'avis que nous avons affaire ici à une Columbellide présentant certains traits primitifs, qui révèlent sa connexion avec d'autres familles à canal plus allongé.

Génotype: *Johnstrupia faxensis* n. sp.

116. **Johnstrupia faxensis** n. sp.

Pl. VI, fig. 3 a—b.

Les détails donnés plus haut, qui sont à considérer comme propres au genre, peuvent être suppléés par la description suivante, qui a rapport à l'espèce.

La spire tout entière recouverte d'un enduit épais de vernis; pour cette raison la suture indiquée seulement par une faible dépression et le nombre de tours incertain mais probablement modique (env. 3?). Tours assez fortement convexes. Dernier tour subglobuleux, à canal court, nettement limité. Ouverture étroite, un peu élargie au milieu, fortement rétrécie en bas, du côté du canal un peu oblique et fortement élargi vers le bas. Labre externe à environ 10 dents courtes et épaisses. Columelle à 4 ou 5 dents horizontales et, en dedans de celles-ci, une ou deux dents courtes, nodiformes; au point de transition à la partie supérieure du bord columellaire une dent oblique, particulièrement forte et longue, et au-dessus de celle-ci, 4 ou 5 dents obliques de longueur un peu différente.

Hauteur, 11 mm; diamètre, 8,5 mm; hauteur de l'ouverture, 9 mm. Les autres exemplaires sont un peu plus petits, et l'un d'eux, surtout, est un peu plus allongé. Peut-être que cet individu appartient à une autre espèce, ce qui ne pourra être déterminé, pourtant, aussi longtemps qu'on ne possède pas de plus amples matériaux.

Calcaire à Coralliaires: 3 coquilles.

Famille: **Buccinidae.**

Genre: Nassa Lamarck (1799).

117. **Nassa? supracretacea** Ravn.

(Voir 1902. Ravn, Mollusk. i Danmarks Kridtafl. II. p. 230; pl. II, fig. 14 et 15).

Cette espèce n'a été augmentée que d'une couple d'individus, dont l'un révèle que le labre interne a été muni d'un nombre de lamelles horizontales. La détermination du genre est toujours très peu sûre, la forme de l'ouverture n'étant pas encore tout à fait connue. Peut-être que l'espèce appartient au genre *Volutilithes,* auquel elle correspond pour le galbe et l'ornementation, mais il n'est pas possible de s'assurer si la columelle a été lisse ou munie de plis.

Calcaire à Coralliaires: 6 individus.

Famille: **Fusidae.**

Genre: Fusus (Klein 1753), Lamarck (1799).

118. **Fusus faxensis** Ravn.

(Voir 1902. Ravn, Mollusk. i Danmarks Kridtafl. II. p. 230; pl. II, fig. 16 et 17).

Calcaires à Coralliaires et à Bryozoaires: rare.

119. **Fusus** sp.

Un moule externe d'un grand *Fusus* est trop incomplet pour le déterminer quant à l'espèce. Le nombre de côtes transverses est beaucoup plus grand chez cette espèce que chez la précédente, attendu qu'on trouve environ 10, même sur les tours d'un certain âge. De plus, les côtes sont plus déprimées, relativement plus larges, et elles s'étendent presque jusqu'à la suture.

Calcaire à Coralliaires: 1 individu.

Genre: Pirifusus Conrad (1858).

120. **Pirifusus? globulosus** n. sp.

Pl. VII, fig. 2 a—b.

Une couple de moules internes sont tellement incomplets qu'ils ne se laissent pas même sûrement rapporter à tel ou tel genre, mais à cause de leur galbe particulier et leur aspect en général ils méritent cependant une description.

Coquille assez grande, à spire très raccourcie. Tours fortement convexes; dernier tour très volumineux, fortement bombé en haut, un peu excavé en bas; ouverture ovale; columelle un peu concave. Canal pas conservé, sa forme donc inconnu. Surface du moule à plis transverses serrés, assez gros, présentant des traces de nœuds rangés en séries spirales.

Il est à espérer qu'on réussira à trouver des exemplaires dont la partie inférieure est conservée, pour rendre possible d'examiner la forme du canal et arriver ainsi à une détermination exacte du genre.

On ne connaît jusqu'ici que peu d'espèces du genre *Pirifusus,* dont la plus ancienne de l'Albien, la plus jeune du Sénonien.

Calcaire à Coralliaires: 2 moules internes.

Genre: Buccinofusus CONRAD (1868).

Ce n'est pas sans hésitation que je réfère les deux espèces suivantes à ce genre, dont les espèces sont ordinairement beaucoup plus grandes, possédant des côtes transverses relativement plus faibles et des cordons spiraux plus gros.

Nos deux espèces semblent ressembler beaucoup au genre *Searlesia* HARMER (1914), mais comme type de ce genre HARMER a choisi *S. costifer* (S. V. WOOD), et cette espèce possède un labre externe épaissi sans plis intérieurs, pour quelle raison il sera malaisé de la rapporter au même genre que les deux espèces décrites ici. Il y a également grande ressemblance avec le genre *Siphonalia* A. ADAMS, mais la protoconque diffère beaucoup.

121. **Buccinofusus? parvus** n. sp.

Pl. VII, fig. 1 a—b.

Coquille petite, largement fusiforme, composée de 4 à 5 tours (protoconque non compris). Angle de la spire, 48°. Protoconque assez obtuse, formée d'environ $3^1/_2$ tours lisses, convexes; nucléus pas dévié. Tours suivants assez convexes, séparés par des sutures distinctes; sur chaque tour 11 à 12 côtes transverses fortes, étroites, et de nombreux cordonnets spiraux serrés. Dernier tour uniformément arrondi; les côtes transverses s'évanouissant rapidement du côté de la base couverte seulement de cordonnets spiraux très variés en largeur, plus larges et plus aplatis à proximité de l'ouverture. Canal assez court, tordu, tronqué à son extrémité et pourvu d'une échancrure indistincte. Ouverture piriforme; labre externe à plis intérieurs faibles, un peu antécurrent en haut; columelle un peu excavée, sans plis; bord columellaire distinctement délimité du tour précédent.

Hauteur, 11 mm; diamètre, 5 mm; hauteur de l'ouverture (canal compris) la moitié de celle de la coquille en totalité.

Un certain nombre de coquilles sont un peu plus allongées que celle décrite ci-dessus et possèdent des côtes plus étroites et plus tranchantes en plus petit nombre. Il semble pourtant qu'il y a des formes transitoires, c'est pourquoi je les ai rapportées toutes à la même espèce. Sur le premier tour le nombre de côtes est quelquefois plus grand que sur les tours suivants.

Notre espèce ressemble à *B. regularis* (SOW.), mais elle possède e. a. des cordonnets spiraux plus nombreux et beaucoup plus délicats.

Le »Nez«: 69 individus.

122. **Buccinofusus? subglaber** n. sp.

Pl. VII, fig. 4 a—b.

Coquille petite, fusiforme, composée de 3 à 4 tours outre la protoconque un peu obtuse, formée d'environ 4 tours lisses, convexes; nucléus pas dévié. Angle de la spire, 44°. Tours assez convexes, séparés par des sutures distinctes. Ornementation formée d'environ 14 cordonnets spiraux, dont les inférieurs délicats, les supérieurs un peu plus gros; outre cela, des plis transverses nombreux, très faibles, assez irréguliers. Dernier tour uniformément arrondi, muni de la même ornementation que les tours précédents. Ouverture piriforme; canal court, un peu courbé, présentant l'indication d'une échancrure. Labre externe mince, presque rectiligne, sans plis intérieurs; bord columellaire un peu déprimé, distinctement limité au dehors; columelle un peu excavée, sans plis.

Hauteur, 9,5 mm; diamètre, 4 mm; hauteur de l'ouverture (canal compris), 5 mm.

Le galbe de cette espèce est très voisin de celui de l'espèce précédente, mais son ornementation en diffère beaucoup. Par rapport à la taille, au galbe et à l'ornementation l'espèce ressemble beaucoup à certaines espèces paléocènes et éocènes, rapportées par Cossmann (Paléoconch. comparée, IV. p. 102—03) au genre *Parvosipho* Cossm., mais attendu que ce genre possède un nucléus dévié et un bord columellaire invisible il s'ensuit que notre espèce ne peut pas appartenir à ce genre.

Le »Nez«: 29 individus.

Famille: **Volutidae.**

Genre: Mitra Lamarck (1799).

123. **Mitra (Volutomitra) quinqueplicata** Ravn.

(Voir 1902. Ravn, Mollusk. i Danmarks Kridtafl. II. p. 232; pl. II, fig. 21 et 22).

Il reste peut-être un peu douteux s'il faille rapporter cette espèce aux *Volutimitra,* considérées par Cossmann comme une section du genre *Mitra.* Elle présente cependant une grande ressemblance avec *V. groenlandica* Beck, génotype de *Volutomitra.* La columelle porte quatre plis équidistants, très obliques, dont trois sont le plus souvent d'à peu près égale grosseur, tandis que le quatrième (l'inférieur) est quelquefois un peu plus faible que les autres; à côté de cela on voit le plus souvent sur les moules internes des traces d'encore un cinquième pli, qui a été situé à une bonne distance au-dessus du quatrième; il est beaucoup plus faible que les autres et peut apparemment faire complètement défaut.

Calcaires à Coralliaires et à Bryozoaires: assez rare.

Genre: Conomitra Conrad (1865).

124. **Conomitra** sp.

Pl. VII, fig. 3 a—b.

Une coquille un peu fragmentaire semble avoir été dépourvue de canal aussi bien que d'échancrure basale, et sera donc probablement à rapporter au genre *Conomitra,* mais elle est trop incomplète pour être déterminée d'une façon plus précise.

Coquille assez petite, au plus près fusiforme, a tours lisses, séparés par une suture distincte. Ouverture étroite; labre externe mince, muni intérieurement d'un nombre de lamelles délicates; bord columellaire faiblement, mais pourtant distinctement déprimé. Columelle à quatre plis, dont les deux supérieurs très gros, fortement saillants et presque horizontaux, le second d'en bas et surtout le plus bas, plus faibles et plus obliques. Tout en bas de la surface extérieure du dernier tour un nombre de cordonnets spiraux délicats.

Hauteur, environ 12 mm; diamètre, 4,8 mm.

Un autre fragment a probablement appartenu à la même espèce.

Pour le galbe et l'ornementation l'espèce rappelle beaucoup *C. distensa* Cossm. et Pis., mais elle s'en distingue e. a. par l'absence d'un sillon au-dessous de la suture.

Le »Nez«: 2 individus.

Genre: Turricula Klein (1753).

125. **Turricula (Fusimitra) subglabra** n. sp.

Pl. VI, fig. 8 a—b.

Coquille petite, fusiforme allongée. Angle de la spire, 36°. Protoconque basse, obtuse, composée d'environ 2 tours lisses. Tours suivants, au nombre de quatre, subconvexes, séparés par des sutures distinctes, couverts d'environ sept cordonnets spiraux diminuant en grosseur vers le bas, tout à fait indistincts sur la moitié inférieure du tour. Stries d'accroissement rectilignes. Dernier tour égal aux deux tiers de la hauteur totale de la coquille, fortement atténué en bas et terminé par un canal court, droit, assez distinctement limité; les cordonnets spiraux du tour visibles seulement juste au-dessous de la suture et à la surface extérieure du canal. Ouverture allongée, à labre externe assez fortement courbé, et bien limitée du côté du canal; labre externe sans plis. Columelle munie de trois plis, dont les deux supérieurs gros, l'inférieur un peu plus faible.

Hauteur, 8,2 mm; diamètre, 3,2 mm; hauteur du dernier tour, 5,4 mm.

Cette espèce est très voisine de *T. wateleti* (Br. & C.) décrite du paléocène belge et français, mais elle s'en distingue par son ornementation et par la courbure plus accentuée de son labre externe. Chez *T. danensis* Cossm. (= *Mitra semilaevis* v. Koen.) du paléocène danois l'angle de la spire est quelque peu plus grand (44° chez l'holotype) et l'ornementation beaucoup plus distincte. Notre espèce se distingue d'autres formes lisses par le fait de n'avoir que trois plis columellaires.

Le »Nez«: 13 individus.

126. **Turricula (Fusimitra) glabra** n. sp.

Pl. VII, fig. 5 a—b.

Coquille petite, fusiforme, assez allongée. Angle de la spire, 36 à 38°. Protoconque basse, obtuse, composée d'environ deux tours avec traces très faibles de costules transverses extrêmement délicates. Tours suivants, au nombre de 5 à 6, subconvexes, séparés par des sutures distinctes; immédiatement au-dessous de la suture un sillon spiral faible; les stries d'accroissement très peu arquées; tours autrement complètement lisses. Hauteur du dernier tour à peu près égale aux deux tiers de la hauteur totale de la coquille, ce tour assez atténué en bas et terminé par un canal court, rectiligne, et orné d'un nombre de stries obliques très délicates. Ouverture allongée, avec transition ininterrompue au canal; labre externe tranchant, sans plis. Columelle à quatre plis, dont les deux supérieurs gros et presque horizontaux, les deux inférieurs (surtout le plus bas) plus faibles et plus obliques.

Hauteur, 10,5 mm; diamètre, 3,8 mm; hauteur du dernier tour, 6,3 mm. Un exemplaire un peu douteux a 18 mm de hauteur et 6 mm en diamètre.

L'espèce correspond pour son galbe très bien à *T. wateleti* (Br. & C.), mais possède quatre plis columellaires au lieu de trois. Elle rappelle fortement *T. gosseleti* (Br. & C.), mais l'ouverture est un peu plus étroite et l'angle d'ouverture supérieur plus aigu; de plus, le dernier tour est un peu plus bombé, sous quel rapport l'espèce se distingue aussi de *T. koeneni* (Br. & C.).

Le »Nez«: 8 individus.

127. **Turricula (Fusimitra) faxensis** n. sp.

Pl. VII, fig. 6 a—b.

Certaines coquilles se distinguent tellement des deux espèces précédentes qu'il faut les rapporter à une espèce particulière.

Coquille assez petite, fusiforme. Angle de la spire, 41°. Protoconque basse, obtuse, composée de 2 à 3 tours lisses. Tours suivants, au nombre de 4 à 6, assez faiblement convexes, séparés par des sutures distinctes; au-dessous de la suture un cordonnet spiral délicat; stries d'accroissement rectilignes; coquille autrement lisse. Hauteur du dernier tour égale aux deux tiers de la hauteur entière de la coquille, ce tour un peu atténué en bas et terminé par un canal très court. Ouverture allongée, à labre externe tranchant, faiblement courbé. Canal pas nettement limité du reste de l'ouverture. Columelle à quatre plis, dont les deux supérieurs extrêmement gros et à peu près horizontaux, les deux inférieurs (et notamment le plus bas) plus faibles et plus obliques.

Hauteur, 9 mm; diamètre 3,7 mm; hauteur du dernier tour, 6 mm.

Cette espèce se distingue des deux précédentes par son galbe un peu plus trapu, son angle de la spire plus grand et son canal plus court. Par rapport aux deux caractères cités en premier lieu elle est voisine de *T. danensis* Cossm., mais cette espèce a une ornementation spirale distincte et ne possède que trois plis. A raison de son canal court, indistinctement limité, l'espèce se rapproche fortement du genre *Conomitra;* ainsi, elle ressemble d'une manière frappante à *C. prisca* (Desh.), dont, malheureusement, je n'ai pas vu d'individus à surface bien conservée. De *T. gosseleti* (Br. & C.) notre espèce se distingue par sa spire plus courte et son galbe un peu plus gros.

Le »Nez«: 5 individus.

128. **Turricula** sp.

Pl. VII, fig. 9 a—b.

Une petite coquille fragmentaire, composée des deux derniers tours, semble se rapporter à une espèce du genre *Turricula s. s.*

Les tours assez fortement convexes, séparés par des sutures un peu sinueuses et portant chacun environ 10 côtes transverses fortes, étroites, et des cordonnets spiraux délicats. Canal rectiligne et assez long. Columelle à trois plis tranchants, dont l'inférieur plus délicat que les autres.

L'espèce se distingue de celles trouvées dans le paléocène de Copenhague par ses tours plus fortement convexes.

Le »Nez«: 1 individu.

Genre: Lyria Gray (1847).

129. **Lyria pindborgi** n. sp.

1902. *Voluta (Lyria?)* sp.; Ravn, Mollusk. i Danmarks Kridtafl. II. p. 233; pl. III. fig. 5.

Dans la page citée ci-dessus j'ai donné une courte description et une figuration d'une Volutide, dont on ne connaissait alors qu'une empreinte extérieure. Le défunt instituteur J. Pindborg, ardent collectionneur de fossiles du Calcaire de Faxe, remit plus tard au Muséum un moule interne de cette espèce, qui est maintenant connue d'une manière assez complète et, par conséquent, accessible à une dénomination.

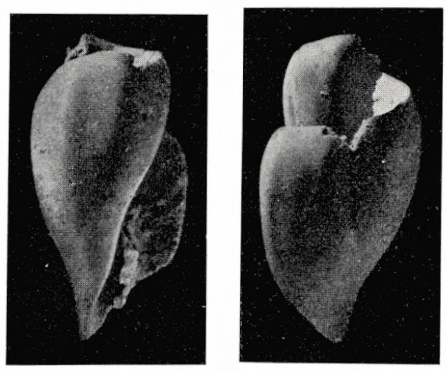

Fig. 6. Fig. 7.
Fig. 6—7. *Lyria pindborgi* n. sp. $^3/_1$. Moule interne.

Fig. 8. *Lyria pindborgi* n. sp. $^1/_1$. D'après un moulage en cire.

A ma description antérieure les traits suivants pourront être ajoutés: Ouverture haute, s'élargissant rapidement vers le bas pour s'atténuer un peu de nouveau tout à fait en bas. Bord columellaire à 9 plis, dont les deux les plus bas plus gros que les autres; au-dessous du pli le plus inférieur se voit la trace d'encore un dixième pli. Les plis inférieurs sont très obliques, tandis que les autres se font de plus en plus horizontaux, en sorte que le plus supérieur, situé un peu au-dessous de la suture, est à peu près parallèle à celle-ci.

J'ai déjà auparavant rendu attentif au fait que l'espèce ressemble beaucoup à *L. crassicostata* Stol. de l'»Arrialaor Group«, mais qu'elle est e. a. un peu plus allongée que celle-ci. *L. mariae* (Br. & C.) est plus trapue, ses tours sont plus bas et son ouverture plus courte.

Calcaire à Coralliaires (?): 2 individus.

Genre: Scaphella Swainson (1832).

130. **Scaphella faxensis** (Ravn).

1902. *Voluta faxensis* Ravn, Mollusk. i Danmarks Kridtafl. II. p. 233; pl. III, fig. 1 à 3.

Bien que cette espèce n'ait que trois plis columellaires je l'ai cependant rapportée au genre *Scaphella*, qui a ordinairement quatre plis, mais auquel elle semble autrement correspondre. *Sc. crenistria* (v. Koen.), qui se rencontre dans notre paléocène, n'a également que trois plis, et c'est le cas aussi pour *Sc. Bolli* (Koch) du miocène, qui, cependant, porte quelquefois trace d'un quatrième pli.

Calcaire à Coralliaires: assez abondante; Calcaire à Bryozoaires: rare.

Famille: **Cancellariidae.**

Genre: Admete Krøyer (1842).

131. **Admete (Bonellitia)** sp.

Pl. VI, fig. 12 a—b.

On possède un exemplaire très jeune d'une espèce appartenant à ce genre. L'espèce ne peut pas être déterminée, on donnera cependant une description très succincte de la coquille.

Taille très petite; forme ovoïde. Protoconque lisse, paucispirée, à nucléus faiblement déprimé. Tours suivants convexes, ornés de filets très faibles au commencement, plus tard assez distincts. Dernier tour très grand, à base convexe et imperforée. Ouverture ovale, pourvue d'un bec assez large, rejeté vers la gauche. Labre externe épaissi, muni de costules internes; columelle portant trois plis obliques, dont les deux supérieurs plus forts que l'inférieur, faisant la délimitation supérieure du bec.

Le »Nez«: 1 individu.

132. **Admete? biplicata** (Ravn).

Pl. I, fig. 12 a—b.

1902. *Tritonium biplicatum* (M.U.H.), Ravn, Mollusk. i Danmarks Kridtafl. II. p. 228; pl. II, fig. 11 et 12.

Sous la vieille dénomination »*Tritonium biplicatum*« (usée par le Musée) j'ai décrit et figuré (l. c.) une espèce, qui est, cependant, à référer aux Cancellariides à raison de ses deux plis, qui se laissent poursuivre tout au long de la columelle. On possède maintenant trois coquilles toutes jeunes, qui sont peut-être des jeunes individus de cette espèce. Elles ont une protoconque basse, à nucléus faiblement déprimé, et à tours lisses, convexes. Les tours suivants portent trois cordons spiraux croisés de costules transverses délicates. La columelle semble n'avoir que deux plis.

On ne peut sans doute pas encore déterminer sûrement si nous avons ici affaire à une espèce du genre *Admete*.

Calcaire à Coralliaires: 35 individus, y compris les trois jeunes individus un peu douteux provenant du «Nez».

Genre: Uxia JOUSSEAUME (1888).

133. **Uxia** sp.

Pl. VII, fig. 7 a—b.

Une seule coquille un peu fragmentaire est à rapporter à une espèce du genre *Uxia*. Elle a malheureusement appartenu à un individu tellement jeune qu'il n'est pas possible d'en déterminer l'espèce.

La coquille a été très petite, ovoïde. Protoconque obtuse, à nucléus aplati, et composée de tours lisses, convexes. Du nombre de tours suivants deux seulement conservés, montrant la naissance successive de costules transverses serrées; pas trace d'ornementation spirale; par contre, une couple de faibles varices placées bout à bout. L'ouverture est endommagée; elle a été ovale, étroite, un peu déjetée, et elle est terminée par un canal court, large. Le labre externe fait défaut. La columelle porte trois plis forts, obliques.

Hauteur, 2 mm; diamètre, 1 mm.

L'espèce en présence ici semble plus allongée que toutes les espèces de »*Cancellaria*« de notre paléocène décrites par v. KOENEN, mais une comparaison minutieuse avec d'autres espèces est rendue impossible par l'état défectueux de la coquille.

Le »Nez«: 1 coquille.

Famille: **Pleurotomidae.**

Genre: Surcula H. et A. ADAMS (1855).

134. **Surcula faxensis** (RAVN).

Pl. VII, fig. 8 a—b.

1902. *Pleurotoma faxensis* RAVN, Mollusk. i Danmarks Kridtafl. II. p. 235; pl. III, fig. 8 et 10.

Une petite coquille, haute de 8 mm, et 3 mm en diamètre, présente une protoconque assez pointue, composée d'environ trois tours convexes. Les tours suivants portent sur leur ligne médiane une carène prononcée; la partie du tour située au-dessus de cette carène est excavée, tandis que la partie au-dessous de la carène est convexe. Au-dessous de la carène se trouvent un nombre relativement restreint de côtes obliques, qui semblent cependant disparaître sur les tours relativement jeunes, où l'on ne voit que des cordonnets spiraux délicats, qui sont le mieux développés au-dessous de la carène. Les stries d'accroissement forment un sinus au-dessus de la carène. Le canal semble avoir été rectiligne et assez court.

Bien que la possibilité existe que cette coquille ait appartenu à un jeune individu de *S. faxensis*, on peut y objecter, cependant, que les côtes semblent disparaître beaucoup trop tôt. Il est à espérer que des matériaux nouveaux nous aideront à résoudre cette question.

Jusqu'ici on n'a cependant pas trouvé de nouveaux matériaux de cette espèce, et il n'y a donc rien à ajouter à la description citée plus haut.

Calcaire à Coralliaires: assez rare.

135. **Surcula? pusilla** n. sp.

Pl. VII, fig. 12 a—b.

Coquille petite, fusiforme. Protoconque composée d'une couple de tours lisses, assez faiblement convexes. Tours suivants séparés par des sutures distinctes, assez fortement convexes, avec trace d'une bande aplatie en haut. Ornementation formée exclusivement de nombreux cordonnets spiraux délicats croisés de stries d'accroissement très faibles; sinus de celles-ci situé tout contre la suture. Canal probablement court et rectiligne. Labre externe un peu arqué en avant sur le milieu du dernier tour.

Hauteur, 5,2 mm; diamètre, 2 mm.

Cette espèce ne peut être sûrement rapportée au genre *Surcula*. Pour l'ornementation elle est plus voisine du genre *Cryptoconus*, mais sa protoconque e. a. diffère de celle de ce genre, et son labre externe est moins courbé.

Le »Nez«: 3 coquilles.

Outre les deux Pleurotomides mentionnées plus haut on a trouvé encore une troisième espèce dans le Calcaire à Coralliaires. Chez celle-ci le sinus de la carène se trouve à peu près sur le milieu du tour; mais autrement les matériaux en présence sont si incomplets qu'ils ne permettent pas une détermination plus détaillée.

Famille: **Conidae.**

Genre: Conus Linné (1758).

136. **Conus** sp.

(Voir 1902. Ravn, Mollusk. i Danmarks Kridtafl. II. p. 238; pl. III, fig. 6).

Malheureusement on ne possède toujours qu'un seul moule interne de cette espèce. Par conséquent il n'y a rien à ajouter à la description citée ci-dessus.

Calcaire à Coralliaires: 1 individu.

Famille: **Atlantidae.**

Genre: Eoatlanta Cossmann (1889).

137. **Eoatlanta spiruloides** (Lamk.).

Pl. VII, fig. 10 a—c et 11.

1824. *Cyclostoma spiruloides* Lamk.; Deshayes, Coq. foss. des envir. de Paris. II. p. 78; pl. 7, fig. 15 et 16.
1889. *Eoatlanta* — — ; Cossmann, Cat. illustr. IV. p. 302; pl. 10, fig. 63 et 64.
1895. — — — ; — , Paléoconch. I. p. 134; pl. 6, fig. 6 et 7.

Coquille petite, composée d'un nucléus globuleux, relativement gros, et trois tours tubulaires, lisses, enroulés en un plan ou presque, à section perpendiculaire circulaire ou faiblement ovale; les deux premiers tours enroulés en spirale fermée, le dernier en spirale détachée. Ouverture évasée, tronquée en ligne droite ou, le plus souvent, un peu en saillie sur les côtés, à coupe transversale faiblement ovale, circulaire ou bien, rarement, ovoïde.

L'une des coquilles figurées (fig. 10) présente les mesures suivantes: diamètre de la coquille entière, 2,5 mm; hauteur du dernier tour et son diamètre un peu derrière l'ouverture, respectivement 0,7 et 0,5 mm; hauteur et diamètre de l'ouverture, 0,9 et 0,8 mm.

Il ressort de la description ci-dessus que les coquilles en présence varient passablement. Cela, du reste, semble être le cas aussi pour les coquilles de l'éocène français. D'après Deshayes, ce n'est que le dernier tour qui constitue une spirale détachée, tandis que, d'après Cossmann, cela est le cas aussi pour les tours antérieurs. La figure fournie par Deshayes présente une coquille absolument symmétrique, dont les tours sont circulaires en coupe transversale, tandis que, dans son travail cité en premier lieu, Cossmann reproduit une coquille distinctement déjetée, dont les tours semblent présenter une coupe transversale décidément ovoïde. Des différences semblables se trouvent chez les individus danois, et pour cette raison je les réfère — non sans quelque hésitation, pourtant — à une et même espèce.

Le »Nez«: 139 individus.

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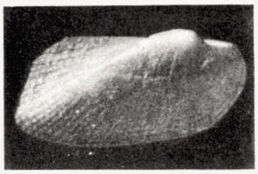
Tous les exemplaires figurés appartiennent au Museum de Minéralogie et de Géologie de l'Université de Copenhague.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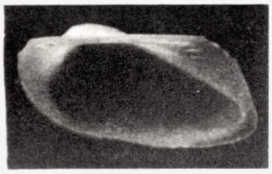
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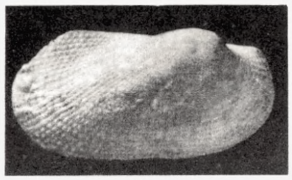
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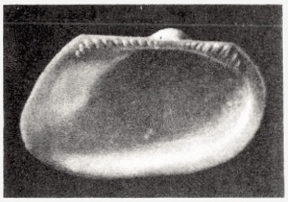
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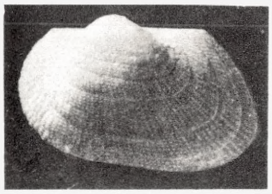
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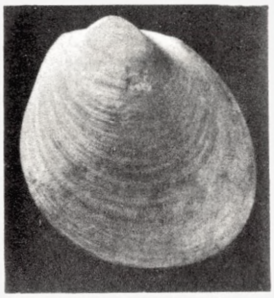
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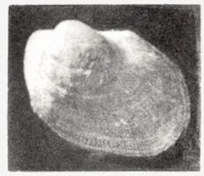
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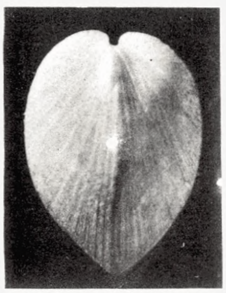
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14 c


15 c

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PACHT & CRONE'S EFT., FOTOTYPI

Planche II.

pages

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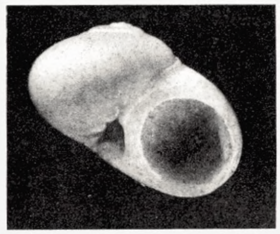
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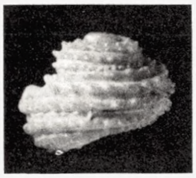
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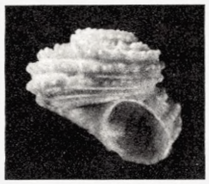
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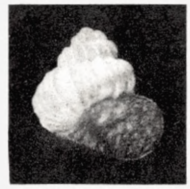
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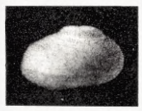
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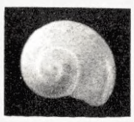
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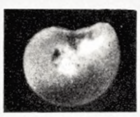
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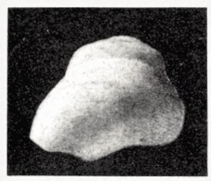
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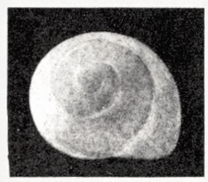
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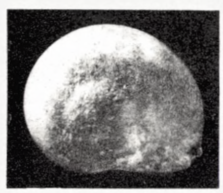
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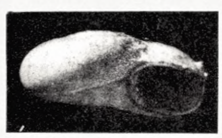
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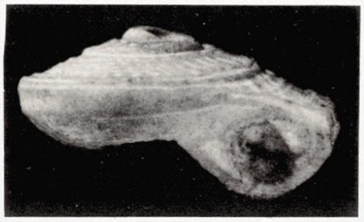
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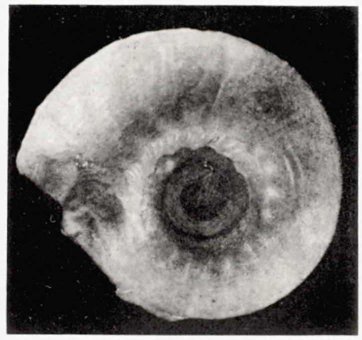
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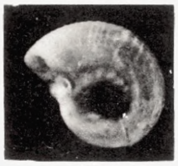
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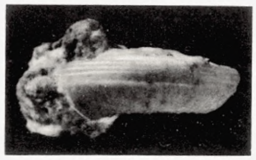
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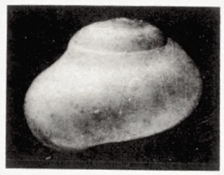
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6 a


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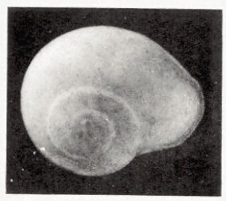
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Planche IV.

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1 a 1 b 2 a 2 b 3 a 3 b 4 a 4 b 5 a 5 b 6 a 6 b 7 a 7 b 8 a 8 b 9 a 9 b 10 a 10 b 11 a 11 b 12 a 12 b 13 a 13 b 14 a 14 b 15 a 15 b

Chr. Poulsen phot. Pacht & Crone's Eft., Fototypi

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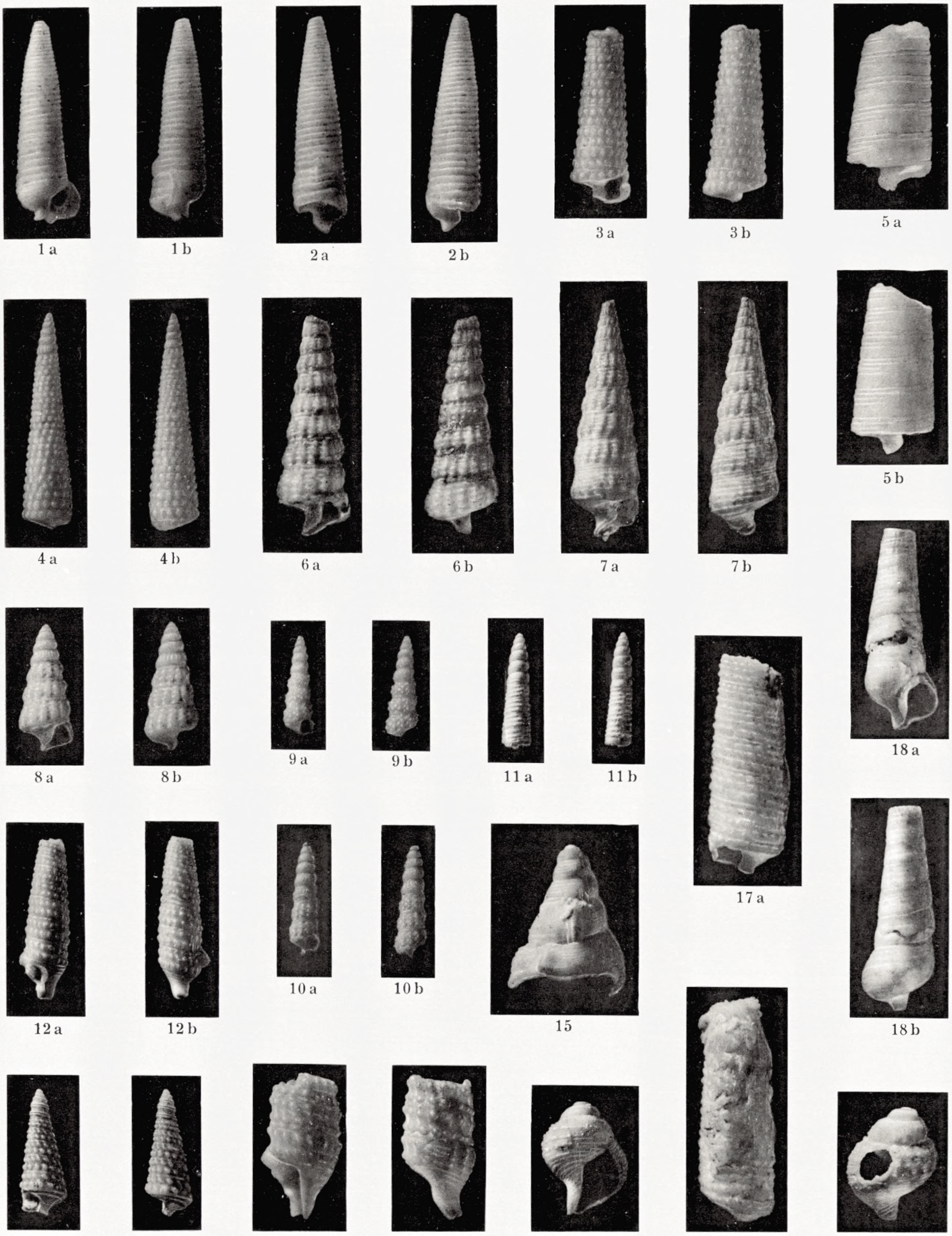

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Planche VI.

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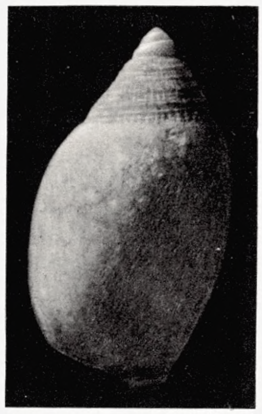
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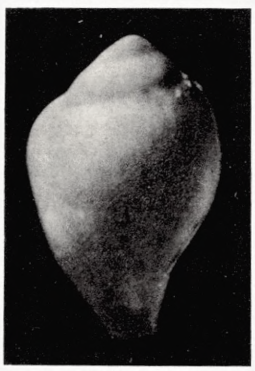
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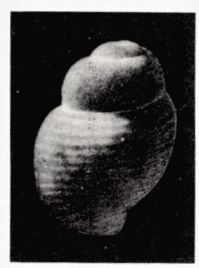
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Planche VII.

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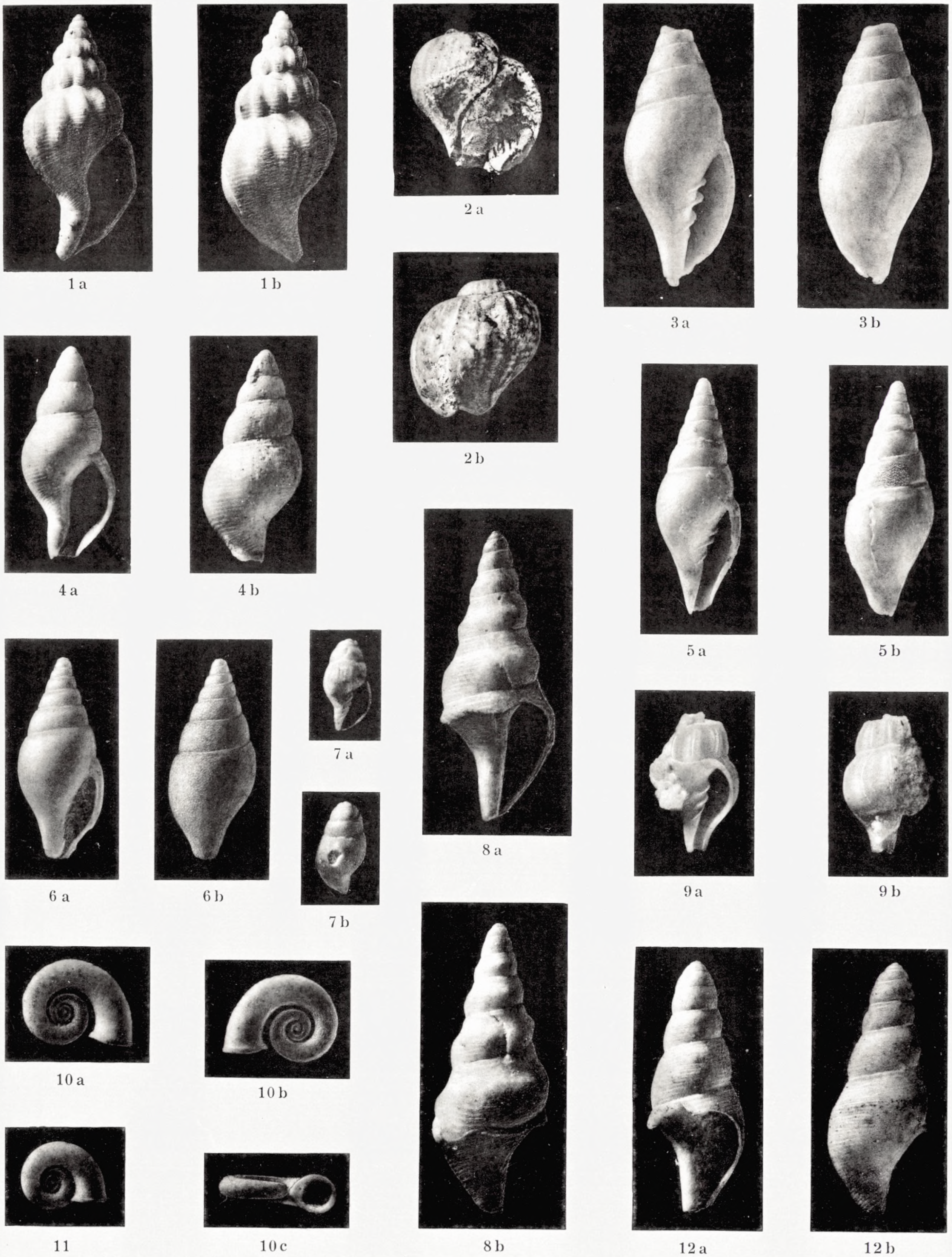
PL. VII



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CONTRIBUTIONS

TO THE

DEVELOPMENT OF THE TREMATODA DIGENEA

PART II

THE BIOLOGY OF THE FRESHWATER CERCARIAE IN DANISH FRESHWATERS

BY

C. WESENBERG-LUND

WITH 35 PLATES AND 4 PLATES OF MICROPHOTOS

D. Kgl. Danske Vidensk. Selsk. Skrifter, naturv. og math. Afd., 9. Række, V. 3.

KØBENHAVN
LEVIN & MUNKSGAARD
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1934

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Introduction.

As is well known, the digenetic Trematoda nearly always pass part of their life in molluscs, mainly in snails. Our knowledge of their development is mainly based upon the study of the phase occurring in fresh-water snails. What we know with regard to their life in marine or land snails is more fragmentary. This is especially true with regard to the land snails. On a close study much would seem to indicate that the trematode life in land snails is a far commoner phenomenon than has hitherto been supposed, and that precisely here will be found many aberrant forms deviating highly from those developing in fresh-water snails. The reader is referred to the recent papers of HARPER (1932, p. 307), NÖLLER und ENIGK (1932, p. 424), MATTES (1933, p. 227). All the Trematoda developing in fresh-water molluscs belong to the fresh-water fauna in their developmental stages.

Curiously enough, recent limnology has never occupied itself with the fresh-water trematodes and this is all the more peculiar since very many live in fresh-water organisms not only as larvae but also as mature animals, and so to speak are true fresh-water organisms during their whole life. Our entire knowledge of the life of digenetic Trematoda has been built up almost exclusively by parasitologists, during recent years mainly in parasitological laboratories from which a series of admirable investigations has been carried out. As far as I know, the fresh-water laboratories and limnologists have devoted their energies to other and more pressing subjects.

During my plancton investigations I have several times obtained Cercariae in the plancton samples. A study of the researches in other countries will show that there too the investigations have revealed Cercariae. In the plancton lists they have always merely been designated as Cercaria sp. Once I found a very peculiar Cercaria larva which will be mentioned in the following, and during my Furesø-studies (1917) I was able to make some observations which awakened my greatest interest and were of considerable importance for the researches now published. Furthermore, during my studies of various water insects, I often found the larvae affected by cysts and as STEENSTRUP (1842, p. 43) had previously done, observed the milky water caused by crowds of Cercariae round the snails in our ditches and on our moors. During more than 30 years a more thorough study of the trematode life, especially of the Cercariae, i. e. that developmental stage in which they live side by side with the Rotifera, the Cladocera, insect larvae and many other fresh-water organisms which I have studied for years, was a desideratum which, however, I never thought should be fulfilled. For there could be no doubt that, if these investigations were to be carried out from a fresh-water laboratory, the whole equipment and its organisation must necessarily be of a much higher standard than that of the small rooms in which the investigations have hitherto been made.

Then came a donation from the Carlsberg Foundation in 1931. A house in Hillerød near the Frederiksborg Castle Lake was bought, and equipped throughout as a fresh-water biological laboratory.

As soon as the laboratory had been established, I decided to study the Cercaria fauna of our fresh-waters. — Furnished as the laboratory is with aquaria, air and water supply, a refrigerator and a thermostat for constant temperatures, for acceleration and retardation of development, a chemical balance, centrifuge, open air aquaria in which the organisms can be reared from eggs, the best possible microscopical and microphotographic equipment, it enables me to accomplish an investigation for which through a number of years I had gathered observations that admittedly I thought would never be published. —

The investigations on the trematode fauna of our fresh-waters now appearing are only a link in the chain of publications relating to the biology of fresh-water organisms published by the Danish Fresh-water Laboratory. As such they have their great limitations; they differ very much from the studies from parasitological laboratories; they finish so to speak where the latter begin. The main task has been to obtain a general faunistic view of the Cercaria fauna of our fresh-waters and contribute to the biology of the parasites in the Cercaria stage. The group has not been studied in our country since the appearance of Steenstrup's famous work. Almost all the species here treated are therefore new to our fauna. A closer study of all those parasites which attain maturity in birds and mammals does not belong to the main work of a fresh-water laboratory, and would demand an equipment which was neither available nor desirable. With regard to all those forms that attain maturity in fishes and amphibia others are already now occupied with subjects relating to them. That the delimitation of the problem as given here will be felt as a great defect I feel convinced. On the other hand the very circumstance that the researches have been made from a fresh-water laboratory and that the starting point is different from the usual one, may be expected to reveal some facts relating to the biology of the Cercariae, thus to the interplay between life and structure, between host and parasite, which perhaps would not be so much in evidence if the investigations were made from a parasitological laboratory.

As is well known, the Cercariae cannot be collected in the same way as Rotifera, Cladocera and other free-swimming fresh-water organisms. It is necessary to take into the laboratory our fresh-water molluscs, especially the fresh-water snails, keep them in aquaria, let them throw the Cercariae and then study these in the vessels. Furthermore it is a well-known fact that many more molluscs are affected than those which throw the Cercariae. At the moment of collection many are parasitised in the Sporocyst or Redia stage, many contain only Tetracotyle but no Furcocercariae; hence dissection of the snails is always necessary. The mode of procedure used for the investigations is as follows. The snails are taken into the laboratory, of the larger species (*Limnœa stagnalis, Planorbis corneus*) 3 are usually put in a glass containing c. 200 ccm., of the smaller ones (*Bithynia*, small *Planorbis* species and others) 5. If any glass shows Cercariae, the snails in the glass are isolated; the infected snail is then put aside, and in this way a collection of infected snails is obtained. Experience shows that snails can retain the Cercariae for a very long time, furthermore that the ripening of the Cercariae in the parthenitæ can take place for months after the sample has been taken; usually the collection of snails was kept under observation for 4—5 days, whereupon the snails were dissected. The snails in the vessels were not fed; in the course of 1—2 days they had given off most of their excrements whereupon they were given freshwater. Later on the water was not changed. If plants are given to the snails, it is more difficult to see and gather the Cercariae; the water gets dirty owing to the large amount of excrements. If only the water is well aerated, snails can be kept upon inanition for months. This applies especially to *Planorbis corneus,* perhaps not so much to *Limnaea stagnalis.* The temperature must not be too high; during the summer half of the year the snails die faster than in the winter half. There is this drawback about the method that Cercariae in snails kept upon inanition and dying have a tendency to encyst in the snails. This is the case with the *Echinostomata, Gymnocephala, Xiphidiocercariae* and *Cercariaea.*

The Cercariae were nearly always studied in the living state; and the drawings, which are all camera drawings, have all been executed from living animals. Staining methods were not used very much. The Cercariae were studied in a 0.35 $^0/_0$ solution of NaCl. During slow evaporation of the fluid the Cercariae pass into a state of asphyxia in which they keep quiet for 20—30 minutes; in this interval the animals are studied and drawn. In most cases the observer has enough living material to replace the dying ones. Just before death the Cercariae are most suitable for study; this applies especially to the excretory system; other observers, (Loos 1894, p. 3, Cort 1918b, p. 129, 1918a, p. 50), have made the same observation.

In most cases it has been necessary to use several animals to obtain a drawing. Simultaneously slides were taken of all animals and preserved in 5 $^0/_0$ formaline. The drawings are all made by myself, but all the statements with regard to the dimensions have been obtained from my assistant, Dr. Berg. Most of the material has been measured in the living state as well as in the slides; in the last-named case in five specimens.

Three of the four plates of microphotos show sections of the Gasteropod liver attacked by the Trematoda. Their main object is to show how strongly the liver is attacked. With regard to the pathological changes produced by fluke-infection I refer the reader to the papers by Faust (1920 d, p. 78), Aggersborg (1924, p. 361), and Hurst (1927, p. 321).

Before the description of the animals the dimensions are given; in the column to the left those of the living animal, in that to the right those of the preserved specimen. The two figures to the right show the dimensions of the smallest and the biggest animal. It is my impression that all in all the systematic value of the dimensions is but slight; the variations in size are too great. Cort (1916, p. 25) has arrived at a similar result with regard to the size of the eggs.

In a group where in most cases we have not the slightest idea to what mature Trematoda a Cercaria belongs, the rules of nomenclature are of course very difficult. Earlier authors gave the Cercariae names; in recent years other methods have been tried. In his great work on the Indian Cercariae Sewell has given them numbers and simultaneously stated that they are Indian forms. His Cercariae are determined as Cercariae Indicae I—LX. Dubois has adopted the nomenclature of Sewell and has a list of Cercariae helveticae I—XXXII. Szidat gives his species letters (Cercariae A—C. Szidat). Harper and Petersen number them but without stating the country (*Cercaria* F_1, Harper, Echinostome Cercaria No. 1 Petersen). In other words, the nomenclature has brought about a really chaotic situation. As many of the Cercariae are unquestionably cosmopolitan, the worst is that we can find Indian Cercariae in Europe, and vice versa. We shall then be faced by the absurdity of determining a Helvetian Cercaria as e. g. Cercaria Indica No. XXX. To this must be added the fact that it is quite impossible to remember clearly the appearance of Cercariae determined by means of numbers or letters. On the other hand, every one who has worked a little with Trematoda knows what *Cercaria monostomi* or *Cercaria ocellata* is. If the nomenclature in recent use is continued we run the risk of getting synonymlists like the following

Cercaria indicae I. Sewell.
— helvetica II. Dubois.
— 4. Petersen.
— D. Szidat.
— F_1. Harper.

In my view the old manner of giving the Cercaria a name was much better. When later on the ripe stage is found to which the Cercaria belongs, the Cercaria with its name is merely placed under the name of the Trematode. Wherever it has been possible, I have referred the Danish Cercariae to forms which have previously been described. Many of the European forms in particular are very insufficiently described and figured, and I know that many of the species mentioned in this work come under the same category. As far as my experience goes, it is always a dangerous matter to describe and draw Cercariae from specimens taken out of the Sporocysts or from the snails. Many structures, e. g. the collar of the Echinostomes or the caudal pockets of the Monostomes, are not fully developed. On the other hand, in very many cases in Cercariae which have nearly finished their free-swimming larval stage, the whole cystogeneous apparatus will cover all other organs, so that a close study is impossible. Combined studies of specimens taken from the snail and from the outer medium seem to give the best results. This, however, compels the inquirer to use many specimens for drawing it, and even if the drawings are made with the camera, many camera-sketches must necessarily be combined. When estimating the drawings, this fact should be kept in mind; that the method is dangerous is quite correctly maintained by LANGERON (1924, p. 24).

In several cases the material at my disposal was very small. From my investigations relating to Rotifera, Cladocera, and other plancton organisms I supposed that next year I could find the forms again and supplement the drawings and descriptions. — In the present case, however, I soon learned that this could hardly ever be done. Even in small ponds the Trematode fauna of our Molluscs differs from year to year, and in the many cases in which I have found the developmental stages of a Trematode in one of several hundred snails, experience has taught me that it is almost impossible to find the form again next year. —

I shall not here enter into a detailed account of the vast literature on the subject. I merely wish to point out the remarkable fact that the chief centre for the study of trematode development has been shifted from Europe to other continents, in the first place to North America, Japan and India. Even if science will always be greatly indebted to the excellent investigations of BRUMPT, DOLLFUS, MATHIAS, and SZIDAT, after the death of ODHNER and the cruel fate of LOOS, there can be no doubt, as is clearly shown by the Japanese authors, by CORT, FAUST, WARD, LA RUE and all their pupils and furthermore by SEWELL's great work on the Indian Cercariae, that the fauna of North American, Japan and Indian fresh-waters is much better known, and the species better described and drawn than is the case with the European forms. My knowledge of the ripe stage of Trematodes being very restricted, hardly any remarks with reference to the mature forms will be found. In this respect I refer the reader to LÜHE (1909) and to the more recent papers of LA RUE and SZIDAT a. o. I cannot but recognise that SZIDAT, with his long series relating to the development of the Trematoda and the sure references of the Cercariae to the ripe stages, has inaugurated a new era in German parasitology which after the death of LEUCKART, BRAUN, and LOOS has lost its votaries. With regard to my own paper, I beg to remind the reader that it is written by a limnologist from a limnological laboratory, not by a parasitologist from a parasitological laboratory. In this fact an excuse for the many lacks and deficiencis may be found.

As often mentioned, the excretory system seems to be that of all the organs which is least influenced by the outer medium. Hence it is unquestionably that which appears to be best suited for systematic purposes, and all the more so since it is the organ which has undergone least alteration in the mature form. It is easily understandable, therefore, that enquirers have laid special stress on the study of this system and have used it to clear up the relationship between the different groups of Cercariae. Especially the investigations of FAUST (1919a, p. 315, 1921, p. 205), SEWELL (1930,

p. 357) and Johnston (1920, p. 335) have contributed to our knowledge of the structure of the organ. There is no doubt that in the various groups of the Cercariae the organ has a characteristic structure in each particular group. Nevertheless I am inclined to think, and so are others with me (viz. Miller 1927, p. 78; Stunkard 1930, p. 273), that the systematic use of the excretory organ can be exaggerated, and that the natural relationship of the Cercariae can only be established, not upon a single organ, but by a sound, exhaustive consideration of the general anatomical structure of the whole organism. There is no doubt that the excretory bladder, its structure and form and the course of the main trunks of the excretory tubes, as well as in some cases the branches of the second order, are of great systematic value. What I fear is to lay too much stress upon the number of flame cells in the different species, and to use the difference in the number as a means by which the species can be distinguished. The greatest systematic value they may have in the *Furcocercariae;* in the other groups, especially in the *Echinostomata*, the *Gymnocephala* and the *Xiphidiocercariae,* it is a dangerous matter to ascribe to them any great systematic value.

In 1920, p. 348 Johnston states that, for the study of the excretory system of *Echinostomum revolutum* he used over 2000 Cercariae, and that the system was studied for a period of five consecutive weeks; the study was only devoted to an account of the course of the excretory canals, and the number and the position of the flame cells.

An organ concerning which the facts are so difficult to unravel, cannot be used for systematic purposes. Add to this that the cystogeneous apparatus in all the abovenamed groups as well as in *Monostomata* and *Cercariæa* hides the organ, in different degrees in the different specimens, and more in older animals than in those which still lie in the sporocysts, and it will be seen that it is quite unavoidable that different authors arrive at quite different results. Furthermore it must be remembered that, during the life of the Cercariae, the flame cells are subject to division, and our knowledge of the rules of this division is extremely slight. The flame cells of the two sides may occupy different positions and I venture to suppose that their number from the two sides is not always identic. The study of the excretory system of the Rotifera, which in my view have their nearest relations in the Turbellariae, would seem to show that the number of the flame cells is augmented with the size. The greater the species is, the greater also is the number of flame cells. This is especially obvious in the *Asplanchna* species. Only in very few cases has the number of the flame cells been used systematically here. It is from these considerations that I have not, in this paper, considered it so important to state the number and position of the flame cells. In the *Monostomata,* where Faust, as far as I know, is the only one who has seen them, I have not observed a single one. Only in the *Furcocercariae* have I tried to give the correct number, but I have refrained from using the formula for the number of vibratile tags which, with its strong expression of exactness, passes the bounds for exactitude which I have set myself. I cannot help thinking that several of those authors who have used this formula may be taxed with the very same thing, and that they have underrated the numerous sources of error which, in my view, it is almost impossible to avoid.

I suppose that more than 10000 snails and mussels have been brought to the laboratory and kept in aquaria. The exact number of the dissected molluscs with information as to localities has been given after the concluding chapter. The localities are almost all situated round Hillerød or in the middle of Seeland around Sorø and Tjustrup lakes. A collection of c. 200 *Limnaea truncatula* derives from the west coast of Slesvig. Most of the snails come from small lakes and ponds. But collections have also been made from our larger lakes, Furesø, Esromsø and Tjustrupsø. It really seems as if the Cercaria fauna deriving from snails from 5—15 m., the greatest depths to which our fresh-water snails go down, has a somewhat specific stamp; this is true especially of the Cercariae of *Valvata piscinalis* which, as far as I know, has not hitherto been studied with regard to its Cercaria fauna. —

As is well known, the snails are parasitised by other organisms than the Trematoda. Many of these organisms have been observed, but this is a study apart. The commonest are *Chaetogaster limnaei*. They may often be found as a coating on the surface of the snails. That they live of the Trematoda is beyond doubt. Recently Wagin (1931, p. 55) found Cercariae in the stomach of the *Chaetogaster* and I can only confirm his finds. See also Wilcox (1901, p. 905). Several times I have found larvae of *Chironomidae*, and curiously enough, in *Bithynia* and *Limnaea* from a depth of c. 4—5 m., a little *Clepsine*. Sometimes the snails have been strongly affected by Infusoria; I should think that a closer study of the Infusoria fauna of our fresh-water snails would yield good scientific results. —

I wish to express my heartiest thanks to the Trustees of the Carlsberg Foundation; without the great gift of the Foundation it would have been impossible to work out the Cercaria fauna of the Danish fresh-waters. Further I have pleasure in thanking to my assistant, Dr. Kaj Berg, whose help has made it possible to carry out the investigations up to the present. I thank him for undertaking the numerous, often tiresome, excursions especially during the past year, and for his work in connection with the calculation of the dimensions of the Cercariae as well as with the microphotos. And last but not least I am under obligation to the many authors who have sent me their papers and given me all the information for which I have applied to them.

I am also indebted to Mr. Ole Hammer who has found material of *Limnaea truncatula* infected with *Fasciola hepatica*.

Chapter I.

Monostomata.

Sewell (1922, p. 22) refers the monostome Cercariae to six different groups: the *Pleurolophocerca* group, the *Urbanensis* group, the *Ephemera* group, the *Lophocerca* group, the *Lophoides* group, and the *Ubiquita* group.

I cannot follow Sewell (1922, p. 315—319) who maintains that all the above-named six groups derive from a common ancestral form, and that in the Monostomes we have a series of sub-groups which show varying degrees of interrelationship. I fully agree with Odhner who maintains the opposite view, namely that the Monostomes form a polyphyletic group which derive partially if not totally from the Distomes, owing to reduction of the ventral sucker. They may be regarded as "reduzierte Distomen" (1907, p. 338). "Ich glaube also, dasz man auf eine gänzliche Zersplitterung der Monostomum-Gruppe gefasst sein musz" (1907, p. 340, 1911 k, p. 181). Dubois (1929, p. 141) adops the same view. To me the *Ubiquita* group of Sewell are true Xiphidiocercaria; it has not been found in Denmark. To the Furcocercariae I refer the *Lophocerca* group and the *Lophoides* group; according to Miller (1926, p. 69) the first-named belongs to the apharyngeal, brevifurcate, monostome Furcocercariae, the other to the apharyngeal, longifurcate Furcocercariae. I regard the two groups the *Ephemera*-group: i. e. the large monostome Cercariae with three eyes, and the *Urbanensis*-group, i. e. the small monostome Cercariae with two eyes, as very closely related to each other, and as a peculiar type of Cercariae whose relationship to other Cercaria-types is very doubtful. They are characterised by the total absence of a ventral sucker. They possess locomotoric pockets at the base of the tail, an enormous amount of cystogeneous cells, filled with a rod-like or granular matter, a very rich pigmentation most conspicuous in the forepart of the body; three or two eyes; a smooth cuticula without spines, no pharynx, but long intestinal coeca which almost reach the bladder. There are no penetration organs or penetration glands. The excretory bladder is globular, giving off anteriorly two excretory canals uniting in the region of the eyes, and in this way forming a peculiar bow with two long parallel legs. The canals are filled with granules. Posteriorly the bladder has an opening and gives off a canal passing through the whole length of the tail. The rest of the excretory system is almost unknown; it is best described by Faust (1919 a, p. 341) in *C. spatula*, here the canals give off in the middle line one branch anteriorly and one posteriorly, the first carrying four flame cells, the last two.

The Rediae are very variable in form; in the fullgrown stage they have almost no posterior locomotoric appendages, while in the young ones, these are always feebly developed and often seem to be absent. There is an often small pharynx, but a very long often sinuous intestine. Whether normally there follows a series of Redia generations after each other, or only one Redia generation before the Cercaria production, is doubtful, but Rediae producing Rediae have been observed. (Loos 1896, p. 197). Further it is a common feature of all true Monostomes that the development of the Cercariae is not completed in the Rediae but in the tissues of the snail, where they are nourished and magazined at a suitable temperature and high barometer. For *C. pellucida* Faust (1917 a, p. 107) says that the Cercariae usually remain in the Redia till they are ripe. Their life as free-living organisms is extremely short; the Cercariae commonly dart to the lighted side of the vessel and here they encyst, often in the course of a few minutes. The process of encystment has often been observed;

Nitzch (1807, p. 257); La Valette (1855, p. 33 Pl. II, fig. A—G); v. Linstow (1896, p. 377); Cort (1915a, p. 12, Pl. I); Sewell (1922, p. 44); Gwendolen Rees (1932, p. 9), and others. Encystment in the snail may take place, but it is not the rule. (v. Linstow 1896, p. 377; Faust for *C. conadensis* (1917b, p. 110)).

Of Sewell's six groups there still remains the *Pleurolophocerca* group to which belongs *C. pleurolophocerca* (Sons), *C. lophocerca* Fil. and *C. indica* VII and VIII Sewell. On all essential points these forms differ from true Monostomes. Their cuticula is spinose in front; the excretory system is of quite another type; there is no transversal commissure and the two main excretory tubes form a loop and bend downwards as in the *Gymnocephala*; there is a rudiment of a ventral sucker and an apparatus of large salivary cells which surrounds the rudiment of the ventral sucker and to which no analogue is found in the true Monostomes; further the Rediae all seem to have a very short intestine and may be extremely thread-like or almost filiforme. I refer these forms to the *Gymnocephala*. It is a question whether *C. lophocerca* (Fil.) is not identical with *C. fulvopunctata* Ercolani which Lühe (1909, p. 186) refers to the *Gymnocephala*. —

Cercaria ephemera Nitzsch. Host: *Planorbis corneus.*

Pl. 1, figs. 1—8. Microphotos Pl. XXXVI, fig. 1.

The dimensions are

Cercariae

	Living	Preserved
Length of body	1130	344—684
Breadth of body	165	163—209
Length of tail	990	337—419
Breadth of tail	45	53—94
Sucker	45	39—49

Rediae

Length	688—930
Breadth	161—262

The body is extremely contractile; fully extended it may reach a length of about 1100; when contracted and ready to encyst it is only 200—210 and then isodiametric. It has a characteristic plumbeous colour, is very opaque and highly pigmented, especially in the forepart. In young not quite ripe animals there are two brown irregular spots, where later on the two dark eyespots, surrounded by pigment, appear. The fully ripe larva is trioculate, with a third eyespot between the two just mentioned. In the young Cercaria only the part around the future eyespots is irregularly pigmented. During growth the pigment slowly develops more and more round the eyespots and now spreads over the whole body, following in the main two lines to its posterior end.

With regard to the eyespots I refer the reader to Faust (1918a, p. 117). The body is capable of altering its form enormously. It may be almost as thin as the tail, then contract so as to be alternately broadest at its base, in the middle, and in the forepart; very often it resembles a cobra, with a broad forepart carrying the pigmented areas and a short blunt snout. It is able to roll over itself, to make the dorsal as well as the ventral side concave, and simultaneously dilate the tail to its full extent, while a moment later it may contract it to only $^1/_4$ of its former length. The whole body is packed with cells with a rod-like substance. Between them, arranged in longitudinal rows, are large irregular vesicular cells, best described for *C. monostomi* v. Linst. by Dubois (1929, p. 30). The adhesive pockets at the posterior lateral angles of the body are strengthened by infolds of the outer cuticula. The central cavity is extremely narrow and communicates with the exterior by a pore on the tip of the projection. Cementing glands were not observed. I regret that I have been unable to observe the fine spines mentioned by Lühe (1909, p. 177). The pockets are locomotoric organs which help the larva to crawl. On a living Cercaria the projections are subject to great form variation; they may be entirely withdrawn and then protuded, whereupon they are evaginated as prominences which are used during the creeping motion over the substratum. It can be directly observed how they seek to catch hold and then loosen their hold, now one now the other. The oral sucker is rather small (40—60) with the mouth at the anterior tip; at its posterior limit the oesophagus begins. The oesophagus is very short and lacks a pharynx. After bifurcation the intestinal coeca almost reach the end of the body. They follow the large excretory vessels; most probably they do not function in the Cercaria stage. The round excretory bladder opens at the base of the tail; two large vessels pass forward from the bladder and unite in the midline, just behind the eyes; their whole lumen is filled with concretions, all small and all of almost the same size; the two vessels form a very conspicuous bow, whose two legs are almost parallel and of the same width. From the excretory pore a single vessel passes backward through the whole tail, but an opening in the tail has not been observed. Neither here nor in any other Monostomes have I been able to find vibratile tags. Inside the thin cuticula of the tail is first a layer of circular muscles followed by a strong layer of longitudinal muscle fibres, and then a space in which many parenchymatous starlike cells are found. The tail has an extraordinary power of contraction and dilatation. The Rediae measure 660—930. They have a considerable ability of altering their form. Pl. I, fig. 8 a—c shows the same Redia drawn in the course of 5 minutes. There is a very strong muscular pharynx followed by a large intestine almost reaching the posterior end. The colour is often red, and the intestine often contains large amounts of food in the shape of fine black granules. Only rarely does the Redia contain more than two to four Cercariae ready to escape. A birth pore and excretory system have not been observed; the former is mentioned by Szidat (1930a, p. 108). In the posterior part of the body is stored a great number of germballs increasing in size forwards. There are no lateral projections; nevertheless the power of locomotion is rather considerable. Rediae taken from snails which have been kept in aquaria from 17/IV to 20/VII, and in which no Cercariae have been developed for two months, are much shorter; they have almost no locomotoric power; they are very dark, they contain only a single Cercaria and very few germballs.

In my area of exploration *C. ephemera* is a very common Cercaria in *Pl. corneus.* It has been found in nine different localities; very often the number of infected snails was very large, about 95 $^0/_0$; double infection with *C. ephemera* and a Xiphidiocercaria is common; in several localities the number was small, only a few per cent. It has also been found in *Planorbis vortex.* For two localities regular observations were made: in one, the moor, Hillerød, in April, May and October 1931, and in April 1932; in the other (Torkeris pond) in May, July, September 1931, and in January, April, May and June 1932. —

Very often the shell of the infected snails is extremely corroded; it is very thin and breaks at the slightest touch; when opened the liver shows a remarkable greyish brown or reddish brown colour. It is often very strongly affected; of the liver substance only very little is left and the surface acquires a peculiar gritted aspect; this is due to the enormous amount of parasites.

When opened, it will almost always be observed that the number of Cercariae is much greater than that of the Rediae; further, as stated above, the number of Cercariae which the Rediae contain is but small, and they are never fully developed. On the other hand, the liver contains enormous amounts of almost fully developed Cercariae. There can be no doubt, as is the rule with the Monostomes, that the Cercariae leave the Rediae before they are fully developed, so that the ripening is completed in the liver itself. Microphoto fig. 1 will show that. — When affected snails are placed in vessels in April—May and brought from the normal temperatures of the ponds (about 4—6° C.) into temperatures of about 15—20° C., they will soon begin to throw out the Cercariae. Regular observations show that only few Cercariae are ejected before 9 o'clock. Then they suddenly appear and often in clouds. They come from the space between the shell and the animal; when the snail has been withdrawn for a short time and then again comes out, a small cloud appears. At 4 or 5 o'clock the ejection ceases. But during the time from 10—4 a vessel containing a single snail may be crowded with Cercariae. The life of the Cercaria as a free-swimming organism is extremely short; a few minutes after the liberation from the snail, they so to speak pounce upon the lighted side of the vessel and fasten themselves there. Faust (1917a, p. 35) says that a whole lot of mature Cercariae encyst in two or three minutes after they are freed from the Rediae. If the vessel does not receive light from one side, they dart towards the shell of the snail, and in the course of a few hours the whole shell may be covered with cysts, often to such an extent that they sit side by side, and the shell is thus covered with a homogeneous layer of glossy cysts. Strangely enough, cysts are hardly ever found upon waterplants. In vessels whose inner side was covered with hundreds of cysts, only a few could be found on the leaves of *Elodea* etc.

In ponds and lakes where *C. ephemera* is common the shell of *Planorbis corneus* is very often covered with cysts. Curiously enough, I have not found them on *L. stagnalis* even if the two snails are lying side by side. As soon as the Cercariae have reached the light side of the vessel, they slide over the glass, using the sucker and the two lateral pockets; the form is incessantly altered, but usually the creeping motion only lasts for a few minutes. It will then be seen that the body acquires a circular form, and immediately after the cystogeneous cells begin to give off a hyaline mass which surrounds the animal. I do not think that it is the cuticula itself which swells and flows out, as Wunder says (1924a, p. 311) with regard to *C. monostomi.* Only the tail is free. Stretched out perpendicularly from the body and in its full length it moves incessantly with a whipping motion at an enormous speed. During the motion two circles are described, an inner, smaller and closed one, and an outer, much larger and open one behind. The secreta flow out around the body of the Cercaria, leaving a little space behind through which the tail is stretched out. Slowly the tail is constricted at the base, and suddenly it breaks off. The process from the moment of attachment to now has only lasted about 15 minutes. Strangely enough, the tail continues its motion for a long time. Already at two o'clock most of the ejected Cercariae have fastened themselves, but the water is still blackish. A close inspection shows that this is almost entirely due to cast-off tails. During their short lifetime as free-living organisms the Cercariae themselves are more creeping than swimming organisms. The next morning the whole mass of tails is deposited on the bottom of the vessel as a fluffy white mass.

As soon as the tail is cast off, and already a little before, the animal in the cyst begins a rotating movement which lasts rather a long time. During that time the cystogeneous cells uninterruptedly exude matter and so the wall of the cyst is thickened by the deposition of layer after layer. In the completed cyst of *C. monostomi* as well as of *C. ephemera* and of *C. imbricata* the wall consists of three layers: an irregular very hyaline one, which will soon be coloured green or brown by algae, a thicker one of a scale-like structure with the scales extremely small and curved, and an inner one of a hyaline concentric structure (Pl. II, fig. 11). When the wall of the cyst is finished, the animal keeps quiet; it soon acquires a brown colour, but for a long time the eye-spots and the sucker are very conspicuous. — The cysts have a glassy appearance and are faintly vaulted like a watch-glass. They are extremely firmly fastened to the substratum. Very often glossy rings occur, but no cysts; they are cysts whose formation has been begun but not completed.

There is no doubt that the ejection of the Cercariae depends partly on the atmospheric pressure. When the barometer is low, in rainy weather and when the sky is overcast, ejection does not take place, whereas it is extremely lively on sunny days with a high barometer.

The temperature and the season have likewise a great influence. —

When *Planorbis corneus* from Torkeris pond and another pond, Donse pond, where *P. corneus* has also been regularly observed, were taken into the laboratory in November—December no Cercariae appeared. On dissection it could nevertheless be shown that of 75 specimens 5 were heavily infected. In these five specimens there were few Rediae, but the number of Cercariae was enormous; they seemed to be fully developed and appeared in the water exactly as in spring and summer; they encysted in the course of a few hours. In January (29/I, 32) 4 of 10 *Planorbis corneus* were found to be infected. None of them showed any Cercariae, but when they were dissected, enormous amounts of Cercariae appeared. On coming into the water, they lay motionless at the bottom of the vessel for some time; however, when the vessel was placed in the biological thermostat at a temperature of 22° C. they began to swim, and a few hours later they were all encysted on the vessel. The ponds were now frozen, but on 6/IV, when the temperature of the water was only 4° C., 40 *Planorbis corneus* were gathered. On 7/IV, 35 threw out enormous masses of Cercariae. The temperature of the water in the vessels was 19° C.

In other words, this means that during the whole winter the Cercariae hibernate in the snail; most of them are produced in the autumn, whereupon they leave the Rediae and are then found free in the liver. The production of Cercariae almost ceases at a temperature near zero. The Rediae themselves are very dark, almost black; they may contain one or two fully developed Cercariae and 6—8 germballs, all of nearly the same size. I had expected at that period to find Rediae producing Rediae; perhaps I have overlooked them. As mentioned under *C. imbricata,* Rediae producing Rediae may exist also among Monostomes.

It is a very peculiar fact that a liver may be crowded with Cercariae for about 5—6 months and nevertheless, during the whole winter, be used as a functioning organ by the snail. In January, and especially in April, it was very difficult to gather the above-named numbers of snails. Very many empty and much corroded shells were found along the banks of the pond. They showed that numerous snails die during the winter, and it seems highly probable that a large percentage have really been killed by the parasites. — On the other hand, that the snails may actually live for a long time with parasites is clearly shown by the following experiment. —

Three snails from 6/IV 32 which immediately showed Cercariae were placed each in its own vessel; during the time 6/IV to 1/V the water was changed every day; every day the snails ejected a large amount of Cercariae; temperature and air pressure influenced the number. During the latter part of April the number diminished, and in the first half of May the ejection ceased altogether. The snails were under regular observation, but no Cercariae could be observed. On 20/VII the snails were dissected. The liver contained only Rediae; no Cercariae were found there; the Rediae themselves were remarkably short. They contained only 1—2 Cercariae and a few germ-balls, all small, and all of the same size. It seemed to me as if the liver would recover and the active role of the Rediae had ceased.

How long the Cercariae can live in the encysted state I do not know with certainty. Vessels whose lighted sides were covered with a thick layer of cysts were set aside on 15/IV and observed at different times. It was very difficult to see when the Cercariae were really dead. As late as June the Cercariae still moved on pressure.

When the vessels were again examined in October, most of them contained Cercariae with a conspicuous sucker, but no motion could be discovered. Many of the cysts were now empty.

It is a well known fact that in the blind gut of our water-birds there often occur monostome Trematodes belonging to the two genera *Notocotylus* Diesing and *Catatropis* Odhner. Lühe and Loos supposed that *C. ephemera* and *C. imbricata* belonged to the developmental cycle of these worms. Szidat (1930 a, p. 105) has tried to solve the question and contributed very much to its solution. He found that the cysts occurred partly on shells, but also in great number on water-plants. As mentioned above, I for my part have not observed this in my aquaria. Szidat now fed geese and ducks with cyst-infected water-plants and later found the ripe worms in the blind gut. The eggs, furnished with very long threads, were ejected with the excrements into the water, and the eggs or Miracidia again infected the Planorbis. There is no doubt, therefore, that *C. ephemera* are swallowed by ducks and geese as cysts and attain maturity in the coecum.

On 20/VII 31, I found, on a moor (Vixø Moor) near Hillerød, in 3 of 30 *Planorbis vortex*, a little Monostome which I refer with some doubt to *C. ephemera* (Pl. I, figs. 4—7). There were not more than 30—35 Rediae in the snail; these Rediae were not long and thin but short, clumsy, very irregular and often furnished with deep indentations. Often the indentation separated an anterior chamber with large Cercariae from a posterior one only containing germ-balls, diminishing in size from the anterior towards the posterior end (fig. 7). The Cercariae were extremely dark, perhaps not quite ripe, the posterior lateral organs were not always fully developed. The size was only half that of *C. ephemera* but, this apart, I found no differences between the specimens from *Planorbis corneus* and from *P. vortex*. The Rediae never contained more than two or three Cercariae; in the snails, there were not more than 60-70 Cercariae. If we have here to do with *C. ephemera*, it is very interesting to note how the small space in *P. vortex* influences not only the form of the Rediae but also the size of the Cercariae. Arrived in the water, the Cercariae swam around; but they would not encyst, and in the course of the day they all died.

Cercaria monostomi v. Linst. Host: *Limnaea* species.

Pl. II, figs. 1—4.

The dimensions are

Cercariae

	Living	Preserved
Length of body	570	390—470
Breadth of body	165	107—174
Length of tail	550	318—405
Breadth of tail	90	76—83
Sucker	70	40—48

Rediae.

	Living	Preserved
Length	2280	1460—1892
Breadth	180	25—314

In the Cercaria stage I have been unable to find any considerable difference between this species and *C. ephemera* Nitzsch; it seems perhaps to be a little smaller; both possess three eyes; the oral sucker, the "triclad" intestine, the excretory system, and the tail seem to be of exactly the same structure in both species. Lühe (1909, p. 179) supposes there is a small pharynx; but neither Dubois (1929, p. 31) nor Gwendolen Rees (1932, p. 9) nor I have been able to see it. The lateral organs according to Dubois (1929, p. 30) possess cementing glands (cellules glandulaires). I regret that I have not found them. The most conspicuous difference in the structure of the two species is that the pigment tends to arrange itself in four parallel longitudinal lines, two dorsal and two ventral ones, which run through the whole body from the pigment-mass around the eyes. However, they are not always conspicuous, and are not developed in young animals. Gwendolen Rees (1932, p. 9) has seen one flame cell on each side of the oral sucker. The differences between the two species are found in the Rediae and in the biology of the two species. Whereas the Rediae of *C. ephemera* are not more than about 1 mm those of *C. monostomi* attain c. 2—3 mm or more.

The Rediae of *C. ephemera* may often be of a very irregular shape with a rather thick skin, much broader in the middle or behind. Often they show deep indentations. Those of *C. monostomi* are very long sacks with a very thin skin, the breadth is almost the same throughout; indentations do not occur. Whereas the Rediae of *C. ephemera* are often of a vivid red colour, those of *C. monostomi* are hyaline and colourless. This may be due to the fact that *C. ephemera* is found in an animal with red blood, but nevertheless it must be noted that the colour is another, more orange, differing much from the cherry-red blood of a Planorbis. The sucker is very small, much smaller than that of *C. ephemera,* and the intestine a long sack filling almost half the breadth of the Redia, and without indentations. Just as in *C. ephemera,* fully developed Cercariae are found in great numbers outside the Rediae, but here the number of Cercariae occurring in a Redia is much larger. It may be 7—8, and then the Cercariae lie in a long row. In these Cercariae in the Rediae not more than two eyes are visible. The intestine almost reaches the end of the Redia, but there is always a part left which is packed with germ-balls increasing in size from behind towards the front (Pl. II, fig. 4).

C. monostomi is found almost exclusively in *Limnaea* species, mainly *L. stagnalis, L. ovata, L. peregra,* and *L. palustris, C. ephemera* in *Planorbis corneus.* Dubois (1929, p. 31) has found *C. monostomi* in *Planorbis carinatus.* In Denmark it has only been found a few times in Tjustrup Lake (on 15/V 32), 1 of 7 specimens in *L. stagnalis;* and on Amager in *L. ovata* (on 27/IV 32) (3 specimens out of 40). None of the snails showed that they were infected. On dissection the whole liver was found to be packed with brood. Suddenly while I was observing the Cercariae, one of them cast its tail and shortly afterwards another did so too. A few minutes after the snail had been opened, very many of the Cercariae had changed into cysts. Lühe (1909, p. 179) says: "Encystierung der Cercarien soll nicht im Freien sondern ebenfalls in *Limnaea ovata* und *L. peregra* erfolgen". This seems to be correct, but hitherto I have not had the good fortune to find monostome cysts in a snail. That the Cercariae of *C. monostomi* behave differently from *C. ephemera* which always live as free organisms for several hours is beyond all doubt.

Owing to the presumed difference in the manner of encystment, but especially owing to the great differences in the structure of the Rediae, the monostome Cercaria of the *Planorbis* and that of *Limnaea,* the two species *C. ephemera* and *C. monostomi,* may provisionally be regarded as specifically different forms. The difference in the way in which the pigment is arranged in the two forms, more diffusely in *C. ephemera,* more in four parallel longitudinal lines in *C. monostomi,* a fact which has already been mentioned by Lühe, would seem to strengthen this view.

Cercaria imbricata Loos. Host: *Bithynia tentaculata.*

Pl. II, figs. 5—11.

The dimensions are

Cercariae.

	Living	Preserved
Length of body	215	143—255
Breadth of body	140	112—132
Length of tail	250	246—307
Breadth of tail	20	44—53
Sucker	45	29—37

Rediae.

	Living	Preserved
Length	1060	1074—1327
Breadth	380	258—272

The body is smaller than that of *C. ephemera* and *C. monostomi.* It is not leaden-coloured but brown, owing to the rich development of pigment, which is spread over the whole body. But here also it mainly follows the parallel longitudinal lines of which especially the two dorsal ones are rather conspicuous. The cystogeneous cells occupy almost the whole body; sections show that here also, just as in *C. ephemera* they are about half the height of the body. Among them are scattered larger cells ("les cellules géantes" Dubois (1929, p. 32)). According to the same author, there are six pairs of irregular cells (cellules glandulaires caudales) in the tail. I have only seen some inconspicuous ones. In the structure of the intestine and the excretory system I have been unable to find any difference from the two above-named species. Whereas all authors allege that they have observed three eyespots, I have never seen more than the two lateral ones clearly; the median one has always been inconspicuous. I can find no differences in the structure of the lateral organs of *C. imbricata* and *C. monostomi*. — The Cercariae live as free-swimming organisms for a short time; then they fasten themselves upon the lighted side of the vessel.

The Rediae are shorter than those of the two first-named species, especially that of *C. monostomi*. The muscular pharynx is rather large, and the mouth itself capable of extrusion as shown in Pl. II, fig. 10. The borders of the mouth-opening are furnished with short spines. I do not know if this is common to all the Rediae of Monostomes, but with regard to *C. pellucida* Faust (1917 a, p. 59) describes a similar organ, saying "In the prepharynx region is a unique piercing organ, probably of ectodermal origin. It is four-lobed and is covered with spines." Like Faust I have observed the rythmic eversion of the organ against the host tissue, and the withdrawal, within the pharynx region. As in all monostome Rediae hitherto observed by me, there are no lateral appendages. Lühe (1909, p. 178) mentions "Zwei seitlichen, bei älteren Exemplaren sich abstumpfenden Fortsätzen in der Nähe des blinden Darmendes". The intestine is very peculiar. It is very broad, not straight, but almost always strongly curved with several windings; this is most conspicuous in the young Rediae. There is not much room for the Cercariae of which only rarely more than 2—4 simultaneously reach the stage with two well-developed eyes before birth. The intestine may or may not almost reach the posterior end of the Redia. Close to it are always found many germ-balls often arranged in two series (Pl. II, fig. 8). Not only the intestine, but also the spaces between the windings may contain a great amount of yellowish red oil globules which give the Redia a yellow tint. —

During the past two years I have dissected about 150 different snails infected with monostomous Cercariae (of *Planorbis corneus* 104, of *Bithynia tentaculata* about 25). In all cases I have only found Cercariae-producing Rediae. On 20/VII 32, out of 30 *Bithynia tentaculata* originating from a little brook near Arresø, two were found in which the Rediae produced Rediae; in one specimen all the Rediae contained Rediae only, in the other only some of them contained Rediae; some of the Rediae contained Rediae as well as Cercariae. In the literature I have only found a single case mentioned. Of this very species Lühe (1909, p. 178) says that: "Anscheinend folgen vor der Entstehung der Cercarien mehrere Generationen dieser Redien auf einander". As far as I know, this is the first case in which this observation has been confirmed.

I regard the above-named species as *C. imbricata* Loos. — Dubois (1929, p. 32) has described a new species *C. helvetica* I, differing from *C. imbricata* in the following three points: The Rediae are smaller, there are no lateral appendages, and the intestine is very large, reaching the posterior part of the Redia. Since the Redia of *C. imbricata* is large, has small lateral appendages, and a thin intestine only reaching "über die Körpermitte", Dubois has made a separate species of it. In the Cercariae of the two species Dubois has found no differences. As long as we do not know to which species the Cercaria belongs, and both are found in *Bithynia tentaculata,* I think it better to refer the form which I have found to *C. imbricata* Loos. I admit that it agrees on all three points with Dubois's specimens. —

In Denmark *C. imbricata* is fairly common. It has been found in 12 localities. Most of them are small ponds, but in one case it was at a depth of 3—4 m. in one of our largest lakes, Esrom Lake. The number of infected snails is never very large. In Esrom Lake (on 29/IX) only two out of 200 were infected, on 14/V only six out of 150. Only rarely did the snails voluntarily give off the Cercariae; in most cases they were only found after dissection. The number of free Cercariae is much larger than that of the Rediae, which rarely surpasses about 30—50; many of the free Cercariae are not wholly ripe and move but slowly; the ripe Cercariae dart towards the lighted side of the vessel and encyst in the course of a few minutes. Encystment on the shells was not observed. —

Double infection with *C. imbricata* and a Xiphidiocercaria was often observed.

After the appearance of Szidat's important paper (1932 a, p. 205) relating to the development of *Tracheophilus sisowi* Skrj. I have hitherto searched without success for the developmental stages of this very interesting form in *Planorbis corneus* and *Planorbis umbilicatus.* It was Siebold (1835, p. 69) and Wagener (1858, p. 88) who in Miracidia of *Monostomum mutabile* found "einen bereits völlig-entwickelten Sprössling" (a Redia). Leuckardt (1886, p. 75) cites the literature. Szidat found juvenile stages of *Tracheophilus sisowi* Skrj. (fam. *Cyclocoelidae*) and discovered the very remarkable fact that *Tracheophilus sisowi* Skrj. did not develop from Monostomes but from distome Cercariae. It was experimentally shown that the *Planorbis* species is the main host for the Miracidium. Siebold's and Wagener's observations have been corroborated. When it leaves the egg, the Miracidium contains a ripe Redia, a Sporocyst stage being omitted. The Redia introduced into the snail with the Miracidium produces no new Redia generations, but there is a direct production of Cercariae; the number of these is but small. The Cercaria does not leave the snail but encysts near the Redia, and is transferred to the final host (Anas) when the snails are eaten. — Entering the intestine when the capsule of the cyst is dissolved, the young trematode pierces the wall of the intestine and enters the lungs with the blood or through the body cavity, and sooner or later reaches its destination, the bronchia and trachea. — These very interesting studies finally elucidated the development of the fam. *Cyclocoelidae,* which was hitherto quite unknown. Undoubtedly the whole development of this very interesting form may also be studied in our fresh-waters. —

Biological Remarks.

With regard to the biology of the Monostomes reference is made especially to pp. 13—16.

If the Monostomes are taken in the limitation here indicated there are four points in the biology to which special attention should be paid. —

1. The development of the Cercariae appears always to take place in a Redia. As far as I know, no one has seen monostome Cercariae develop from sporocysts.

On the other hand, the old observation by Siebold (1835, p. 69) and Wagener (1858, p. 88) with regard to *Monostomum mutabile* and *flavum*, and the recent observations of Szidat (1932a, p. 205) with regard to *Tracheophilus sisowi* Skrjabin, corroborate the fact that the Rediae of Monostomes may develop directly from the Miracidium without any Sporocyst stage. Whether this is the general rule is another question.

2. The development of the Cercaria is not completed in the Redia itself but in the snail where the Cercaria is most probably nourished by the blood of the host. A connection between the two facts: no Sporocyst stage and development of the Cercariae outside the Rediae, would seem fairly probable. Omitting the Sporocyst stages the Monostomes have not the same power of enormous germ production as most of the other Trematoda. For this purpose they only possess the Redia stage. Curiously enough, the number of Redia generations seems to be small; only very rarely are daughter Rediae observed; the Rediae almost always contain Cercariae, but very often we find a few half-grown Cercariae ready to be hatched, and then, in the posterior part of the Redia, very many germ-balls all nearly the same size. It may perhaps be allowable to suppose that the Rediae produce sets of Cercariae over a very long period, which mature to the birth stage, one after the other. The enormous amount of Cercariae produced, often greatly surpassing that of the Rediae, would not seem to contradict this view. The immense production of Cercariae in a Trematode without Sporocysts and few generations of Rediae would not be possible if the development of the Cercariae were to be completed in the Rediae.

3. No intermediate hosts occur. Encystment takes place either in the open, on stones, water-plants, etc. or perhaps in the snail in which the Cercariae are hatched. It is a question if this latter form of encystment is normal. The life of the Cercaria as a free swimming organism is very short; normally restricted perhaps to only a few minutes. —

4. All monostome Cercariae hitherto known seem to be strongly phototactic, and the moment when the Cercariae leave the snail appears to be dependent upon the light and a high atmospheric pressure. Whether there is any connection between these facts and the remarkably strong pigmentation, much stronger than in almost all other Cercariae, remains to be shown by further investigations.

Chapter II.

Amphistomata.

The amphistome Cercariae are always recognisable from all other Cercariae by the very large ventral sucker bordering the posterior part of their body, and the peculiar course of the main excretory canals which are filled with globular masses of refractive excretory matter. They are among the largest Cercariae known. Owing to the big body and the relatively feeble tail the power of locomotion is but slight. They live near the bottom; their life as free-swimming organisms is but brief. —

The Rediae have or have not posterior locomotoric appendages (two pairs: *C. inhabilis* Cort 1915a, p. 21), best developed in the younger stages. The intestine is short, often not longer than the well-developed pharynx. There seems to be only one Redia generation. The Cercariae leave the Rediae at a very early stage of development, and are nourished directly by the tissues of the snail. —

The encystment regularly takes place in the open; there is no intermediate host; encystment in the primary host, the snail, has been observed.

Most of our knowledge with regard to the development of the Amphistomes derives from the studies of Loos. In 1892, p. 147, he described the Cercaria of *Amphistomum subclavatum* (= *Cercaria diplocotylea* Pagenst.); in 1896, p. 177 the development of *Gastrodiscus ægyptiacus* (Cobbold) and of *Amphistomum conicum* R. (1896, p. 185), showing that *Cercaria pigmentata* Sonsino really belonged to this species.

Cort (1915a, p. 24) referred these species to two groups. To the one was referred *C. pigmentata* Sonsino, to the other the two other above-named Cercariae. To these Cort added three American forms. The first belonged to the subfam. *Paramphistomidae*, the other to the subfam. *Diplodiscinae*, and Sewell (1922, p. 66) created two groups, the *Pigmentata* and the *Diplocotylea* group, and added three Indian forms to the *Pigmentata* group and one to the *Diplocotylea* group. The two groups are best distinguished by the absence (*Pigmentata* group) or presence (*Diplocotylea* group) of pharyngeal pouches. Later on Faust (1919b, p. 173) added an African form and Mc. Coy a new form from Missouri (1929, p. 200). Beaver (1929, p. 13) and Krull and Price (1932, p. 13) each contributed one form. The number of species of the *Diplocotylea* group is now 10, of which only two belong to the European fauna.

Only very few Amphistomes are recorded from Europe. Reference may here be made to the lists of Fukui (1929, p. 219) and Lühe (1909, p. 36 and p. 180). *Paramphistoma cervi* and *Diplodiscus subclavatus* are the main forms; the former is found in the mature stage in plant-eating mammals, the latter in amphibia. It is rather peculiar that the Amphistomes are only represented by so very few species in the European fauna and that, as far as I can see, they belong mainly to the tropical or subtropical zone; further that the Amphistomes which are common in the temperate zone mainly develop in aquatic animals such as frogs, salamanders, snakes, turtles. It is a question if this distribution is really normal and if the extinction or ever-increasing scarcity of great mammals in the temperate zone has not caused the extinction also of the parasites, so that we have mainly kept those species which develop in aquatic animals. After the papers of Loos especially Cort (1915a, p. 24), Sewell (1922), Brumpt (1929b, p. 262), Krull and Price (1932, p. 1) and Chatterley (1931, p. 177) have added to our knowledge of this noteworthy group. From his own observations of the development of *Paramphistomum cervi*, and drawing on the literature, Brumpt (1929, p. 262) points out that the Cercariae of the Amphistomes are born in a very early stage, and that the Cercariae are free parasites in the tissues of the snail, where they attain full development. KRULL and PRICE (1932, p. 18) confirm this observation. BRUMPT gives very instructive photos. I can only corroborate the observation, but I think it may be added that, at any rate as far as my experience goes, this is also the case with all Monostomes. —

Cercaria diplocotylea FIL. Host: *Planorbis umbilicatus.*

Pl. III, figs. 1—4. Microphoto Pl. XXXVIII, fig. 18.

Cercariae.

	Living	Preserved	
Length of body	850	746—955	
Breadth of body	550	337—466	
Length of tail	1760	554—866	
Breadth of tail	170	101—143	
Anterior Sucker	180	103—159	
		Length	Breadth
Posterior Sucker	350	184—200	213—3

Rediae.

Length	2600
Breadth	680

It is very difficult to give a correct description of the form of the Cercaria, because as swimming as also as a creeping organism, it is always changing its form. The figures shown (fig. 2 a—c) are half camera, half freehand drawings of the same animals, drawn in the course of 5 minutes. When the animals alter their shape from that exhibited in fig. 2 a to that seen in fig. 2 c, it is as if a wave passes forward from the tip of the tail, whereupon the animal, when this stage is reached, remains in that form for some time. It is a characteristic feature that three rather sharply defined dilatations are almost always observed in the tail, and that a snoutlike process before the eyes is commonly very conspicuous. This part of the body especially is extremely mobile and variable in form.

The Cercaria is very opaque, owing to the large amounts of pigment, most abundant in the forepart and around the eyes (not drawn in the figure); it consists of blackish brown specks scattered through the whole thickness of the body. The opaqueness is also due to the strongly developed cystogeneous glands, occurring dorsally as well as ventrally, and filling out the whole space between the oral and ventral suckers. The glands appear as small round or pear-shaped bodies, filled with rod-shaped granules (not drawn in the figure). — There are two very conspicuous, highly developed eyes, composed of a large lens and a pigment cone; between them lies the bandlike grey brain. There are no papillae around the mouth. It opens into the oral cavity; posteriorly the oral sucker is furnished with two pharyngeal pockets. The oesophagus is a long thin tube which, immediately before the bifurcation of the coeca, shows a transversal muscle striation. It looks more like a pseudo-pharynx than like a real one. The two coeca have thick walls and a remarkably long transversal course, and, with the lateral one, almost reach the ventral sucker. The ventral sucker is enormous, filling more than a third of the ventral side. Owing to the opaqueness of the animal, it is very difficult to study the excretory organ. The triangular bladder is rather small, it is placed immediately before the ventral sucker. It gives off two broad transversal excretory canals, which form a loop just above the posterior part of the coeca, whereupon they pass forwards, curving inwards below the transversal parts of the coeca whereupon they form a large bow outwards, and turning forwards they reach the eyes. I have not been able to see the returning canals in the forepart of the body, but in the posterior part they have been seen as two thin ramified canals reaching the sides of the ventral sucker; flame cells were not observed. The broad parts of the excretory tubes are filled with refractive globules. From the bladder there issues posteriorly a large single tube, passing through the whole length of the tail; the lateral canals opening near the tip of the tail have been overlooked (observed by Loos a. o.). In the middle of the body lies a dense circular mass which is the beginning of the reproductive organs. —

The tail is extremely mobile; it may be only one-third of the body length or longer than the body. It may also be as broad as the body or only one-fifth of its breadth. It is attached a little above the acetabulum; it very often breaks off. Circular muscles were not observed, but a layer of longitudinal ones, and inside of them a layer of irregular parenchymatous muscles. — When swimming, the animal presents a peculiar appearance (Pl. III, fig. 3) owing to the fact that the tail is first thrown up along the sides of the body, and then backwards, describing two curves, the first with the opening anteriorly, the other larger, with the opening posteriorly.

The Redia (Pl. III, fig. 4) exhibits some peculiar structures. It is commonly of a long, often cylindric, form; there is no collar, nor are there posterior locomotoric appendages; it often tapers posteriorly. The pharynx is rather large and globular; the stomach is not much larger than the sucker, it is of a regular globular form which I have not hitherto found in Rediae; it is connected with the sucker by a very short oesophagus. It is of a peculiar yellow colour and contains a number of small strongly refractive bodies. The walls are very thick. Strangely enough, in numerous specimens there occurs a dark pigment spot, beginning laterally between the stomach and the body wall; in some cases it is not present, in others only faintly developed. When fully developed, it looks like a pigment eye. The Rediae contained germ-balls and Cercariae in a very early stage of development. Posteriorly they are very small, arranged in two rows; they increase in size anteriorly, and are then only present in a single row. Rediae in Redia production have not been observed. As is always the case with the Amphistomes, the Cercariae leave the Rediae at a very early stage and are found scattered in the tissues of the snail. —

Cercaria diplocotylea was found in *Planorbis umbilicatus* in eight of a hundred specimens and only in a single locality in a small pond at Regnstrup Overdrev near Sorø. It was found on a journey, and I had no opportunity of studying the biology. A brief account of the literature relating to the very interesting process of encystment may be given here. LANG (1892, p. 83) shows that the encystment takes place on frogs. Infection follows when the frog swallows its own skin with the cysts attached. Loos (1892, p. 166) points out that the frogs do not commonly swallow their own skin, and that many cysts may be found at the bottom of the ponds, and are introduced into the alimentary canal, especially during winter, when the frogs hibernate on the bottom of the ponds and feed on the sediments accumulated there. Young Amphistomes together with fragments of cysts have been found in the digestive system and near the parasites. Interesting supplementary notes have been added by KRULL and PRICE (1932, p. 1). The intermediate host of *Diplodiscus temperatus* is *Heliosoma trivolvis* but curiously enough all attempts to infect the snails "ranging in size from newly hatched to mature ones" were without success. Loos (1892, p. 155) successfully infected *Planorbis nitidus* and *vortex* with Miracidia of *Amphistomum subclavatum*. An infected snail kept in an aquarium from 26/X 1929 to 2/VIII, 1930, according to KRULL and PRICE shed Cercariae every day; as in other species there was a special time of the day when most of the Cercariae were shed; in this case the afternoon. Their lifetime is not more than half a day. Encystment begins as soon as the water evaporates and has become so shallow that the Cercariae are exposed to the air of the atmosphere. This does not happen in aquaria with a large amount of water; even if pebbles, lettuce and dry leaves are placed in the container, no encystment takes place. On the other hand, encystation occurs, especially on the pigmented spots, as soon as frogs are placed in the aquarium. According to the authors, the encysted stage sometimes lasts a few days only. KRULL and PRICE further show that frogs become naturally infected by devouring their own stratum corneum on which the Cercariae encyst, tadpoles by eating Metacercariae which they pick up with the pond ooze. The authors further point out the interesting facts that free-swimming Cercariae are drawn into the mouth of the tadpole with the respiratory currents, and that these Cercariae immediately encyst in the mouth cavity and, when carried into the intestine, are infective. — Similar investigations on our European frogs would be of great interest.

Chapter III.
Gymnocephala.

At the present stage of our knowledge, the gymnocephalus group of Cercariae is in a state of chaos, and cannot be divided into sub-groups. With SEWELL (1922, p. 89) I dissent from LÜHE's view that the *Gymnocephala, Echinostomata* and *Xiphidiocercaria* must be referred to a special group, the *Leptocercaria;* on the other hand, I cannot see that the subdivision of Sewell into four groups: the *Parapleurolophocerca* group, the *Isopori* group, the *Agilis* group, and the *Reflexa* group, is of any value with regard to the European forms. Many of the European species have only been observed once, and described by Filippi (1854—1855—1859) from Italy. The American forms described by Cort (1915 a, p. 31) and others, and the Indian ones described by Sewell (1922, p. 94), show structures which we do not find in the European forms. On the other hand, these do not appear to be referable to the American or Indian groups. How doubtful the subdivisions are can best be seen from the fact that Cort (1915 a, p. 31) (*C. megalura*), as well as Sewell (1922, p. 89) (*C. Indica XIV*), have described forms which cannot be placed in any of their groups.

In Denmark we possess:

Cercaria fasciolae hepaticae Thomas
— *tuberculata* Fil.
— *papillosa* Fil.
— *helvetica XIX* Dubois
— *grandis* n. sp.
— *obscura* n. sp.
— *lophocerca* (Fil.).

As far as I can see, we have to do with four different types: The *C. tuberculata*, *C. papillosa*, *C. helvetica XIX* and *C. grandis* represent one group. The others represent each one group. Especially according to Gwendolen Rees's account, *C. fasciolae hepaticae* seems to differ conspicuously in form from all other Gymnocephala; *C. helvetica XVII* and *C. lophocerca* which is most probably identical with *C. fulvopunctata* Ercolani, referred by Lühe (1909, p. 186) to the *Gymnocephala*, are only with doubt placed here.

As far as I can see, the European gymnocephalous Cercariae have the following characters: Two suckers, which only rarely differ very much in size, the ventral sucker commonly lies behind the middle line of the animal, it has no rows of spines.

No stylet or stylet glands, but often salivary glands. —

A strong development of cystogeneous glands.

A well-developed pharynx, oesophagus and intestinal coeca which commonly do not reach much behind the ventral sucker; the whole organ often very inconspicuous; it may be of the rhabdocoeleous type. The excretory system with the two main excretory tubes which almost reach the oral sucker, here forming a loop, whereupon they pass backwards, almost reaching the bladder; a posterior tube in the tail; most probably it has normally two lateral ducts.

A Sporocyst stage as far as I know has only rarely been observed. The development of the Cercariae takes place in Rediae, with a well-developed collar and posterior locomotoric appendages. Encystment as a rule takes place in the open without any intermediate host, but in many cases and perhaps under bad life conditions in the same snail in which they have been hatched. —

Some of the species which have been regarded as Gymnocephales will only with difficulty be brought under this definition. This applies especially to *C. lophocerca* (Fil.) = *L. fulvopunctata* Ercol. whose place in the system will always be doubtful. —

Of the gymnocephalous Cercariae LÜHE (1909, p. 182) distinguishes 10 different species.

Whereas LÜHE mentions species from *Limnaea* species and from *Paludina vivipara*, curiously enough I have, apart from *Limnaea truncatula*, never found gymnocephalous Cercariae in any of these snails; all the other six species derive from *Bithynia tentaculata*.

Cercaria Fasciolæ hepaticæ Thomas.

Pl. XXXV, fig. 1—8.

The Sporocyst and Redia are described by LEUCKART (1882, p. 80), the Cercaria by THOMAS (1883a, p. 99, 1883b, p. 469) to whose descriptions the reader is referred. See also WRIGHT (1927, p. 47).

The dimensions are:

Cercariae.

	Preserved
Length of body	200—360
Breadth of body	130—240
Oral sucker	60
Ventral sucker	70
Length of tail	400—700

The body is extremely variable in form; fig. 4 shows some of the commonest forms, all drawn from the same individual, and in the course of a few minutes. It may often be heart-shaped, as figured by LEUCKART, THOMAS, and GWENDOLEN REES, but very often it is rectangular or almost quadrangular as is the case with most of the other Gymnocephales; there are no caudal pockets, but the tail is often a little withdrawn into the body; the thin cuticula of the body is covered with very small papillae, which are arranged in transversal rows. The oral sucker is almost terminal and a little smaller than the ventral one, which lies a little behind the middle line of the body; it bears no concentric rows of minute spines; it is strongly protrusile. The whole body is extremely opaque, almost dark, filled as it is with a large amount of cystogeneous cells; in young animals, especially in those which still lie in the Rediae, they are not so strongly developed, lying as two broad dark bands one on each side of the sucker; in specimens which have lived for several hours in water they almost hide all organs, forming a broad transversal ridge around the ventral sucker. With regard to the difference between cystogeneous and parenchymatous cells I refer the reader to GWENDOLEN REES (1932, p. 11) and with regard to the alteration of the tissues preceding the cyst formation, to BOVIEN (1931, p. 223). After a short prepharynx follows a well developed pharynx, whereupon the oesophagus at a short distance from the ventral sucker divides into the two intestinal coeca which almost reach the posterior edge of the body. The excretory vesicle consists of two parts which are only for a short time filled simultaneously. From the anterior part issue two crescent-formed canals with their broadest part a little above the ventral sucker. Along the outer side of the canals runs another, very thin one, whose junction with the broad canals I have been unable to see. Of vibratile tags Wright (1927, p. 47) saw 7, Gwendolen Rees (1932, p. 12) 10 on each side. Posteriorly from the bladder issues a tube which at a distance of about one-fifth from the apex of the tail divides into two branches opening on each side of the tail. The tail itself is a strong locomotoric organ with transversal and especially strongly developed longitudinal muscles. The interior is filled with parenchymatous cells fastened to the walls by long threads. The tip of the tail is peculiar. More than in most of the other Cercariae it is always altering its form. In the course of a few minutes it may be blunt, drawn out in a long acute point, or drawn in again, so that the tail seems to end in a cup-shaped sucker-like organ.

Normally the life of the Cercariae seems to be extremely short, never more than 24 hours. I have seen Cercariae come out of the Rediae and in the course of half an hour encyst upon the cover under the microscope. In vessels they always seek the lighted side and encyst there in the course of a few hours. The material forming the cyst wall flows out from the whole surface of the body; first comes a very hyaline mucous substance, which agglutinates the cyst to the substratum, and then the material from the cystogeneous glands, forming the inner cyst wall; in the course of some minutes the cyst is formed and shortly afterwards the tail, which has moved vigorously during the whole process, is thrown off.

The Redia is an oblong body differing very much in form in the various specimens; the older they are, the more aberrant is the form. There is a conspicuous collar; the two posterior locomotoric appendages are best developed in the young stages; in the old ones they may be totally absent; a birth-pore is usually conspicuous. The voluminous pharynx opens in an intestine which in the older stage may be $^1/_7$ to $^1/_8$ of the length of the body, but in the younger ones more than half of the body length; a series of muscles run from the collar and the intestine to the body wall. The excretory system is very conspicuous (Pl. XXXV, fig. 5); it consists of two canals, the one passing forwards the other backwards, and uniting above the locomotoric appendages in which a series of branched canals may be observed, both carry at their tips a number of vibratile tags which are difficult to observe, owing to the abundant progeny which generally fills the interior of the Redia. A full grown Redia usually contains about 20—30 germs; daughter Rediae as well as Cercariae may be present simultaneously, but as a rule the Rediae produce either Rediae or Cercariae. The number of full-grown Cercariae rarely seems to surpass 2—3; when pressed, they may often be observed to pass out of the birth pore. In the old stages is often observed an anterior part, with the intestine and the few full-grown Cercariae, and a posterior part containing the germ balls.

The Rediae which, especially in the younger stages, have a considerable power of locomotion, pass from the lung cavity where they have been developed in Sporocysts (Thomas) along the alimentary canal till they have reached the liver, where the further development goes on.

Owing to its great economic significance, originally pointed out in Europe but later on realised in all continents and in almost all climates, the life history of the liver flukes and especially that of *Fasciola hepatica* has been very carefully studied. In its broad features it was, as is well known, cleared up simultaneously by Leuckart (1882, p. 80) and Thomas (1883a, p. 99). Nevertheless it cannot be denied that there still remained many points in the biology of the animal which required elucidation and especially those of economic interest. Some of these points are enumerated below.

1. Is *Fasciola hepatica* strictly bound to the single snail *Limnæa truncatula*?

2. Investigations in Europe seemed to show that this was practically so; simultaneously foreign explorations showed that the rot had a much greater extension than the snail, and that it occurred over areas where *L. truncutula* was never found. Hundreds of thousands of sheep are killed in North-America, in Africa, and in Australia, and the disease is present in Asia. The question then arises: What was the host in these areas?

3. In Europe *L. truncatula* is the main host. It deviates from other *Limnæa* species by being more terrestrial than these; in arid periods of the year it may almost be regarded as a land snail. It was to be expected that an extermination of the rot would be dependent upon the extermination of the snail, and this again demanded a more extensive knowledge of the biology of the snail.

4. A more elaborate study of the life history of *Fasciola hepatica* was highly desirable on many points. As *Fasciola hepatica* has a larva with a vigorous locomotoric organ, only to be used in water, the question was how the Cercaria would behave if living in a snail which for the greater part of its life was found outside water.

5. Thomas has shown that encystation takes place, but no knowledge was gained as to where the cysts were found in nature. It could be regarded as highly probable that sheep and cattle were infected by eating the grass containing the cyst. But it was of the greatest economic significance to know how long the encysted Cercariae kept their vitality intact, and to find out if they could endure desiccation and be brought with the hay into the loans and from them during the whole winter be able to infect the animals.

6. Even if it could be regarded as proved that infection of sheep and cattle was established by means of cyst-infested hay, the possibility could not be denied that infection might also take place in other ways: 1) by drinking water infested with swimming cysts detached from the hay; 2) from infested snails found in the grass and swallowed with it; 3) from free Cercariae swimming in the morning dew upon the meadows; these suppositions were worth experimental study.

7. The degree of infestation of the snail, and the main time for the infestation of sheep and cattle.

Owing to a long series of elaborate studies these points may now be regarded as elucidated; this paper cannot bring new facts about them, and mainly for the following rather peculiar reason.

In spite of the fact that the rot is by no means rare in Denmark, even though we have not suffered from large epidemics, I have searched in vain for infested *L. truncatula* material. *L. truncatula* is a rather sporadically occurring snail, and in my area of exploration I have only rarely seen it. It was rather common at the inundated borders of Tuel Lake near Sorø; several hundred snails were dissected, but the parasite was not found in one of them. During two summer sojourns near the great now almost desiccated bay Lammefjord, on whose now rarely inundated or totally dry meadows many sheep and cattle pasture, *L. truncatula* was found and in several localities near the great estate Dragsholm; more than 500 snails were dissected; not a single one was infested. As is well known, the rot is epidemic in the Ditmarsken, and rather dangerous in the western part of Sønderjylland. For this reason my assistant, Dr. K. Berg, at my request gathered about 200 *L. truncatula* and that in localities where the veterinary was sure that there was a strong infestation of sheep and cattle. In this case too no Cercariae were found; at that time (June 1933) I had almost given up the hope of getting the Cercaria. A young student from my classes, Mr. Hammer, who was studying another subject and traversed a great deal of the country on a motor cycle offered to make enquiries about epidemic foci, and if such were found, to try to find *L. truncatula*. In this way material was brought to the laboratory from Bornholm, Samsø, Møen and from the northwestern part of Seeland a locality where the rot, according to the veterinary, was very wide-spread. The material from this latter locality was rather scarce; it consisted of only about 100 very small individuals and 5 large old snails. One of these snails contained about 50 large Rediae, which harboured several Cercariae, some of them were free in the snail, and lived some hours in the water, whereupon they encysted in the vessel. On all essential points it was in accordance with the figures of Thomas and Gwendolen Rees to whose descriptions I have only very little to add.

As a matter of course I am unable to bring new facts which could be used to elucidate the above-named 7 points. Undoubtedly an elaborate study of the rot in Denmark, as compared with the occurrence of *Limnæa truncatula*, must be regarded as a desideratum, which I hope the future will bring.

With such an investigation in mind, I think it allowable to gather from the literature what is now known with regard to the above-named 7 points.

1. Is *Fasciola hepatica* strictly bound to the snail: *Limnæa truncatula*?

With regard to this point the reader may in the first place be referred to Mehl's excellent work: Die Lebensbedingungen der Leberegelschnecken (1931). It has often been supposed that other *Limnæa*-species, especially *Limnæa pereger* and *L. palustris*, but also *L. stagnalis* were used as hosts by the parasite. It has been shown experimentally (Leuckart 1882) that the Miracidia attack *L. palustris* and *L. pereger*, but the development does not reach the Cercaria stage. Thomas (1883a, p. 106) arrived at the same result. Nöller and Sprehn (1924, p. 369; 1925, p. 611), Taylor (1922, p. 701), and Walton (1918, p. 232) have either shown that the development may exceptionally take place in *L. stagnalis*, or have really found Cercariae of *Fasciola hepatica* in *L. pereger*. From all that we know, there can be no doubt that *L. truncatula* is the main host in Central Europe, and that occurrences in other snails may be regarded as exceptions.

2. As stated above, the rot is spread over a great deal of the world where *L. truncatula* does not occur. A series of investigations show that the parasite here mainly uses other *Limnœa* species, but also species of the genus *Physa* and others.

Sandwich Islands: *Limnœa oahuensis, L. rubella:* Lutz 1892, p. 783 and 1893, p. 320. South Africa *Isidora* (*Limnœa*) *natalensis* and *tropica: Limnœa truncatula:* Porter 1925, p. 309, Cawston 1924, p. 67. Australia: *Physa* species: Gilchrist 1910, p. 658; Venezuela *Ampullaria luteostoma:* Iturbe and Gonzalez 1918; North America: *Limnœa humilis:* Stiles and Hassal 1898 and *Physa fontinalis acuta* Boyd 1921, p. 39; Victoria: *Bulimus tenuistriatus* after Gwendolen Rees 1932, p. 11. East India: *Limnœa minuta javanica, Physa:* Smith.

3. With regard to the life history of *L. truncatula* Mehl (1931), Brockmeier (1898, p. 153), Walton (1918, p. 232), Patzer (1927, p. 321) have given a long series of facts which are of the greatest importance in the fight against the rot. I give the following main points.

The supposition often maintained that *L. truncatula* is only a hunger form of *L. palustris* (Brockmeier) is not correct (Walton, Patzer, Mehl). *L. truncatula* is in the first place limited to small brooks from where in wet summers and during periods of inundation it is carried across the meadows and deposited in great masses in ditches, which later on may dry up. This explains why wet summers and a great downpour is so often followed by a great outbreak of epidemics. It is much more terrestrial than other *Limnœa* species; it does not follow the retreating water in drought periods; the eggs are often found above the waterline, and nevertheless they are able to develop for a long time (Patzer). According to Mehl the egg masses are always deposited in the water, not on dry land.

The length of life differs in the various localities, in some localities it is not a whole year, in others never more than two; the development of the egg masses takes about 1—6 weeks, commonly 2—4.

The snails endure total desiccation of the locality for $4^1/_2$ months, and during the dry period press the opening of the house against the dry mud; they do not dig themselves down into the mud; as true water animals they seek the cracks in the drying mud or in the root system of grasses etc. Against earlier suppositions (Alsterberg 1930, p. 115) Mehl maintains that in nature the snail is extremely little sensitive to temperatures below zero; there is no hope that strong winters with snow will reduce the amount of snails, if only there is a sufficient amount of water. See also Patzer (1927, p. 359—361).

Especially in the young stages cutaneous respiration is of much greater significance than lung respiration. It appears that no help is to be expected from the avifauna for the destruction of the snail (Mehl). Whether this also holds good for the small waders, I regard as very problematic.

It may be added that Schmid (1930, p. 256) has shown that *L. truncatula,* apart from *Fasciola hepatica,* harbours a Cercaria fauna which for its further development requires a permanent sojourn in water. This applies especially to the Furcocercariae of which Schmid has found three species. Also Echinostomes have been found. Korkhaus too (1929, p. 268) has found *Tetracotyle* in *L. truncatula* as well as Monostomes.

4. The number of eggs which a single *Fasciola hepatica* may produce is asserted to be very large (2 millions according to Weinland and Brandt (1926, p. 258)); the number of eggs always present in the oviducts is calculated to be 45,000 (Leuckart 1886—1901, p. 228).

When the eggs are deposited, they are uncleft; it has been experimentally shown that at a temperature at about 25° C. and in clear water the eggs are hatched in about 9 days; below 10° C. no development takes place; temperatures above 25° C. prevent the development. Optimum for ph is for the development 7.5—8; for the hatching of the larva 6.5 (Mattes 1926, p. 145). The eggs do not endure a high degree of desiccation but find a sufficient degree of moisture especially in the excrements to keep alive for a long time (more than a year (Mattes 1926, p. 140); eggs which are exposed experimentally to temperatures of ÷ 7° C. die, but they endure temperatures of ÷ 3 (Mattes). Mehl (1931, p. 6) shows that the Miracidium must reach a snail in the course of 8 hours. He maintains that in his area of exploration (Franken) the rainwater pools in moist meadows and with a summer temperature of about 20—25° C. are the localities which are best fitted for the development of the eggs, and where the greatest amount of eggs are hatched. Mehl correctly maintains that investigations in nature are still a desideratum. When snails, as Mehl has shown, may be present in such great amounts in localities of this nature, when almost all sheep and a high percentage of cattle are infected in the same locality, and the snails themselves may be infected to the extent of 90 %, there must be periods when the shallow water must be almost milky with Cercariae; the same phenomenon which both Steenstrup (1842, p. 43) and I have often seen with regard to other Cercariae (mainly Xiphidiocercariae). Wright (1927, p. 47) has shown that if *L. truncatula* which have been kept dry are put into a drop of water, this will in the course of a few minutes be filled with Cercariae. It may be supposed that the Cercariae during dry periods are kept alive in the snails for a long time, ready to be hatched as soon as water in any form comes in contact with the snail; sudden showers after a period of drought and perhaps only a heavy morning dew, which for some hours wakes the snails, may perhaps be all what is necessary to cover our meadows with a layer of Cercariae which a few hours later are changed into cysts.

As a Cercaria the parasite is extremely sensitive to all influences, as a cyst practically almost insensible. If this is correct, it is a question if a great amount of larvae could not be destroyed in the early summer mornings with dew on the meadows or often with a heavy downpour. I recall here Thomas' proposal to throw salt on the meadows, and draw attention to Leiper's proposal of irrigation ditches; furthermore to Chandler (1920, p. 193).

Thomas (1883 a, p. 118) is the only observer who has seen the asexual propagation of the Sporocyst by means of division, and gives a figure of it (1883 a, Pl. II, fig. 9); according to Mehl (1931, p. 8) only 12 Rediae develop in the Sporocyst. The figures of Thomas seem to indicate a much higher number. The Rediae are very active, using their collar and posterior locomotoric appendages; the short intestine is filled with material from the liver of the snail. Whereas Leuckart says (1886—1901, p. 275) that daughter Rediae are only produced during the winter, Thomas (1883 a, p. 126) maintains that daughter Rediae are only produced in warm weather; in the cold months there was always a direct production of Cercariae. If this is correct, this would be in contradistinction from what we find elsewhere where the production of Cercariae almost always belongs mainly to the summer season. The whole development in the snail from Miracidium to Cercaria may at any rate take 7 weeks; hibernation takes place in the snail and mainly as Rediae. The Cercariae are only hatched when water is present, but the amount of water need only be drops (Walton 1918, p. 264). The snail may retain the fully developed Cercariae for a long time (how long we do not know), whereupon they may be liberated in the course of some days when snails which have lived on dry land are put into water. Of the number of larvae developed in a single snail the suppositions have been extremely exaggerated; some authors speak about millions. All more sound calculations, as those by Leuckart (1886—1901, p. 276), Thomas (1883 b, p. 627), Mehl (1931, p. 11) seem to show much smaller numbers; from a single Miracidium most probably only a few hundred Cercariae develop and more than 100 are not found simultaneously in a snail. The number of Miracidia which may develop in a snail is most probably rather restricted, since too great a number during the development of the parthenitae will kill the snail. The development of the Cercariae is said to be greatest in June—July; the first Cysts are found on grass in July, their number is greatest in September—October, the two months when sheep and cattle are said to be most heavily infected.

5. We are indebted to Nöller and his collaborators for a series of valuable investigations which have shown the localities for the deposition of the Cysts, their resistance to drought; their form variation during desiccation; and which have clearly pointed out that the infection of sheep and cattle takes places in the encysted stage of the parasites, the Cysts being carried with the hay into the alimentary canals of the animals.

I refer the reader especially to Nöller (1925, p. 1); Nöller und Koncek 1928, p. 154; Nöller und Schmid (1927, p. 96); Nöller und Sprehn (1924, p. 369, 1925, p. 611); Nöller und Ulrich (1927 b, p. 789) further to Ort and Sprehn 1925, p. 1021 and 1051 and Marek (1927, p. 513) Mehl (1931).

6. It has been maintained (Ssinitzin 1915, p. 280) that infection took place through free-floating Cysts, detached from the grass and carried with the drinking

water into the cattle. Furthermore Raillet, Moussy and Henry (1913, p. 95) have maintained that they have infected sheep by giving them snails as food. Even if infection may take place in one of these two ways, there cannot be much doubt that infection mainly takes place by means of Cysts deposited on the vegetation; this is also in accordance with the mode of infection of so many other Trematoda which in the cyst stage are well adapted to wait till they are swallowed by the final host together with the vegetation, and also to be liberated from the cyst wall by the chemical influence of the gastric juices.

It is a matter of course that, when it has been proved that infection takes place in the Cyst stage, it is of the greatest importance to know how long the cysts can withstand total desiccation. Practically, this means in other words whether infection takes place not only from fresh hay but also during winter feeding from hay which has been magazined for months in the loans.

Whereas several investigators have maintained this, the more elaborate studies of Nöller and Schmid (1928, p. 96; 1929, p. 327) and Nöller and Koncek (1928, p. 154) seem to show that the danger of infection from even insufficiently dried hay is relatively small, and that hay which has been dry for 5—6 or 7—9 months cannot be a source of infection; Mehl (1931, p. 49) arrives at the same result.

Cercaria tuberculata Fil. Host: *Bithynia tentaculata.*

Pl. III, figs. 5—9.

The dimensions are:

Cercariae.

	Living	Preserved
Length of body	185	187—210
Breadth of body	110	141—161
Length of tail	220	212—296
Breadth of tail	30	37—49
Anterior sucker	45	35—52
Ventral sucker	40	44—64

Rediae.

Length of body	..	289—488
Breadth of body	..	201—270
Pharynx	..	62—70

The Cercaria is very dark, very opaque and peculiarly broad, often almost isodiametric. Apart from the tail, the body is everywhere covered with acute papillae arranged in rows. The tail is somewhat longer than the body. There are no eyespots; no fin membrane on the tail. The oral and the ventral sucker are nearly the same size, the last-named a little smaller. The ventral sucker lies behind the centre of the body with its posterior edge almost touching the bladder. The alimentary canal has a well-developed pharynx, and an oesophagus which bifurcates near the ventral sucker. The intestinal coeca are very difficult to observe, hidden as they are by the cystogeneous apparatus. The cystogeneous glands, before evacuation, occupy almost the whole part of the body, mainly presenting themselves as two lateral bands running nearest to the lateral edges of the body; they consist of large pear-shaped or elongate cells, filled with rod-like granules; they open dorsally or ventrally everywhere on the body. Cort (1915a, p. 35) has shown for a related species, *Cercaria megalura,* how the cellules diminish in size after encystation. Mathias (1925, p. 92) alleges that he has observed two canals opening at the dorsal border of the oral sucker. These canals I also have observed, but I am in doubt as to whether the whole enormous cystogeneous apparatus pours its material through these ducts; however, I have been unable to see any special glands for these ducts. Exudations from the skin during the formation of the cysts I have observed in echinostome Cercariae; in the gymnocephaleous *C. megalura* Cort (1915a, p. 32, fig. 33, Pl. IV) mentions and figures the openings of the cystogeneous cells through the skin.

The broad excretory vesicle gives off from its two anterior corners two broad excretory vessels packed with granules. Owing to the cystogeneous apparatus I have been unable to see the returning canals and vibratile tags. An excretory pore in the vesicle was not observed, but from its posterior border issues a canal which runs medianly through two-thirds of the length of the tail, branching into two canals opening laterally. Genital organs were observed as a cell-mass behind the ventral sucker.

The Redia is very variable in form, differing with the age. The pharynx is always large. When young (Pl. III, fig. 7), newly born, the Redia has well-developed posterior locomotoric appendages. The tail is short, acute; the gut very long, reaching the appendages. In the anterior part four muscles are very conspicuous. In the older Redia the appendages grow smaller; the length of the intestine is not augmented, and the part behind the appendages is filled with globules with large nuclei, viz. the first developed germballs; before them are found serially globules from which the brood is developed (Pl. III, fig. 6). In still older Rediae (fig. 8) the appendages entirely disappear. Commonly the gut only extends through half the length or an even still smaller part of the body. The body is extremely variable in form and so is the intestine. The mouth may be expanded collar-fashion and again withdrawn. The large Rediae are packed with brood and often contain many Cercariae ready to hatch.

This Cercaria was found in *Bithynia tentaculata,* 42 specimens of which were dissected from Donse Pond near Hillerød on 9/VII, and in Hulsø near Frederiksdal on 27/VI 32, and in Bromme. It was always only found in few specimens. One of them voluntarily gave off the Cercariae; the other only after dissection. The Cercariae swim very little. As Mathias (1925, p. 93) has observed, they are negatively phototropic, mostly creeping near the bottom. For *Cercaria megalura* Cort (1915a, p. 32) mentions that the Cercariae become attached to the substratum by the extremity of the tail, and he figures a peculiar adhesive organ, at the posterior tip of the tail. It has not been observed elsewhere in gymnocephalous Cercariae.

The free-living stage is extremely short, the Cercaria often encysts on the object-glass under the microscope, often as soon as the fluids from the snail are mixed with the water. Loos (1896, p. 201—203) has a similar observation with regard to *C. distomatosa*. The cyst is shown in fig. 9; it is very hyaline and has a small indentation in its posterior part. As mentioned by Mathias (1925, p. 94), it has two layers. The same author shows that it may endure desiccation for 40 days.

I refer this form to *C. tuberculata* Fil. Mathias (1925, p. 95) has shown that it develops in *Psilotrema spiculigerum* Mühl. His description and my own agree very well. Only the spinosity of the body is more strongly developed in his specimens than in mine (Mathias, Pl. IV, fig. 9). Mathias has fed white mice as well as *Anas moschata* with the cysts of *C. tuberculata*. Both forms, those of the mammals as well as those of the birds, developed in *Psilotrema spiculigerum;* they were also developed in various other birds. The normal host would appear to be birds, especially *Anatidae;* the structure of the animals is the same in the mammal and in the bird, only specimens from the bird are larger and their spinosity more developed.

Mathias arrives at the result that a Trematode may develop in a long series of hosts, but that in this series there will be one or a few which are the main hosts, where the maximum size is attained, and where the development takes the normal time (not interrupted before the normal period has passed).

Cercaria papillosa Fil. Host: *Bithynia tentaculata*.

Pl. IV.

The dimensions are:

Cercariae.

	Living	Preserved
Length of body	275	227—472
Breadth of body	185	138—155
Length of tail	340	189—278
Breadth of tail	45	40—53
Anterior sucker	50	44—58
Ventral sucker	60	53—68

Rediae.

	Living	Preserved
Length of body	1520	898—1046
Breadth of body	180	222—583
Pharynx	80	74—97

As in *C. tuberculata* there are no eyespots, nor is there any fin membrane on the tail. The ventral sucker is larger than that of *C. tuberculata*. In preserved material its size varies extremely. It may be the same size as the oral sucker, but often it is a little larger. The most characteristic feature is that the whole body is covered with numerous relatively large papillae, which give it a dark, peculiarly dotted aspect.

There is a rather small pharynx; the intestinal coeca branch off immediately before the ventral sucker, and do not reach the posterior border of it. The cystogeneous glands occupy the whole space between the excretory vessels and the lateral borders. The bladder is large, the two anterior excretory vessels are very broad and contain a large amount of big granules. I have seen faintly the returning vessels and two pairs of vibratile tags, one near the anterior sucker, the other pair laterally, on a level with the bladder. — From the posterior part of it a very broad vessel is given off, which does not extend through more than a third or half the length of the tail. It terminates rather acutely (Pl. IV, fig. 2). Lateral canals were not observed.

The Rediae are very variable in shape, with a small pharynx, a well-developed collar, a birth pore, and an intestine of very varying length, in old individuals not extending through more than half the length of the Redia. In the younger stages the posterior locomotoric appendages are well-developed. In one of the specimens parts of the excretory vessel were conspicuous (Pl. IV, fig. 3). The whole interior is packed with immense masses of brood, and the Cercariae are often found crowded together. In May Rediae are found in Redia production. A new-born Redia is drawn in Pl. IV, fig. 10.

As free-living organisms the Cercariae seem to behave exactly like *C. tuberculata*.

The host is *Bithynia tentaculata*. With regard to encystation, it seems to encyst in the snail itself. On 1/X 31, of 70 *Bithynia tentaculata* taken from Furesø 4 contained *C. papillosa*. The peculiar thing was that in one of the four I could find no Rediae. The Cercariae were all creeping about, but possessed no tail. The *Bithynia* was in the same vessel as another one which had thrown off numerous Cercariae. Some of the Cercariae were almost isodiametric, but no real cyst was formed. No doubt the Cercariae had just found their way into the snail and were ready to encyst.

I have found *C. papillosa* in small ponds at Hellebæk and at Fønstrup as well as in material from a depth of 4 to 5 m. in the Furesø. There especially the number of infected snails is rather large, e. g. 5 of 40 or 8 of 50; but in smaller ponds too, as at Hellebæk, the number may be large, e. g. 9 out of 30. The *Bithynia* seem to be infected the whole year round; the Cercaria production is greatest during the summer. —

In Furesø, on 13/V, when the temperature of the water was only 5 degrees, 3 out of 40 *Bithynia* were found with a very peculiar Redia; most of them contained immature brood, but in a few a not quite ripe Cercaria was found, unquestionably a Gymnocephale.

The Rediae were extremely irregular (Pl. IV, figs. 4—11). Some of them, presumably the oldest ones, had an anterior stalk-like dark part ending in a flat expansion (fig. 8). Then followed a long part containing the great stomach, filling almost the whole anterior part in which no brood was observed, then a part which often contained nothing, and finally one or two oblong or globular parts packed with brood. The pharynx was extremely small. There was a collar, very differently developed; in the old Rediae the posterior locomotoric appendages were almost absent. Some of the forms were quite fantastic. As *C. papillosa* is found in the *Bithynia* of Furesø, and the very small pharynx and short intestine is in accordance with the structure of the Redia of *C. papillosa*, I suppose that we are here concerned with very old Rediae of this species, which have hibernated. But I am not sure that this interpretation is correct. Among them there occurred very young, newly born, Rediae with a rather large pharynx and large lateral posterior appendages (Pl. IV, fig. 11).

Cercaria helvetica XIX Dubois. Host: *Bithynia tentaculata.*

Pl. V, figs. 1—3.

The dimensions are:

Cercariae.

	Living	Preserved
Length of body	240	239—254
Breadth of body	165	149—200
Length of tail	210	152—213
Breadth of tail	50	31—68
Anterior sucker	45	42—53
Ventral sucker	60	57—63

Rediae.

Length of body	250	638—1305
Breadth of body	85	236—328
Pharynx	40	74—101

The body is very dark; the skin is neither spinose nor covered with papillae. It is smooth all over. The cystogeneous cells present two very broad bands, rather dark and almost hiding the whole of the internal structure. The cells are filled with rod-like granules; they pour their matter directly through pores into the skin. The ventral sucker is larger than the oral one and is placed almost in the middle of the animal. The prepharynx is very short, the pharynx itself is large and globular, and the oesophagus rather long. The ends of the intestinal coeca have not been observed with certainty. The excretory system consists of a bladder, often broad, triangular, and two strongly developed anterior excretory vessels filled with large globules, not present in a great number. The caudal excretory canal bifurcates almost in the middle line of the tail.

The Redia is very clumsy, the pharynx small, the intestine very broad, often filling the first half of the body (Pl. V, fig. 3); the other part is often separated from it by a constriction and contains a large amount of germ-balls or young Cercariae. There is a rather inconspicuous collar; the posterior locomotoric appendages are only well-developed in the young Rediae and are almost obliterated in the old. —

Host: *Bithynia tentaculata.* In Lühes descriptions all gymnocephalus Cercariae with the ventral sucker larger than the oral one derive either from *Limnaea* species or from *Paludina vivipara;* the measurements of that from *Paludina* do not agree with my specimens.

Dubois (1929, p. 40) has described a species, *helvetica XIX*, which on all essential points agrees with mine; it seems only to be smaller than his species. Hence I refer it to this species.

The species was only found in one locality, the rivulet Værebroaa, near the Roskildefiord. (17/VII 31). The *Bithynia* were strongly infected. Of 20 specimens 11 contained the parasite. Most of them produced free-swimming Cercariae.

Cercaria grandis nov. sp. Host: *Bithynia tentaculata.*

Pl. V, figs. 4—6.

The dimensions are:

Cercariae.

	Living	Preserved
Length of body	340	219—270
Breadth of body	210	156—196
Length of tail	380	190—338
Breadth of tail	60	34—59
Anterior sucker	55	42—53
Ventral sucker	85	48—59

Rediae.

Length of body	..	830—1634
Breadth of body	..	240—752
Pharynx	..	69—120

The form is very large, dark, the skin is remarkably thick, but neither spinose nor covered with papillae, smooth. The body is of the common gymnocephalous form, the tail very strong, broad. No eyes. The cystogeneous cells are arranged in two broad bands, smaller anteriorly and broader behind; in the bands they are in the main arranged in two rows; the cells are large, with large nuclei and packed with granules; special ducts have not been observed. The ventral sucker is always much larger than the oral one; the prepharynx is very short, often invisible, followed by a large globular pharynx. Behind it are found about 10—12 oblong pear-shaped cells, arranged in two rows, with the acute points turned inwards and with conspicuous nuclei. They are arranged around the oesophagus. The posterior ends of the intestinal coeca have not been observed with certainty. The excretory system presents some peculiar structures. The excretory bladder is large, almost rectangular, and gives off anteriorly two excretory vessels not very large and containing only about 12—15 rather large granules arranged in a single row. The vessels reach the oral sucker, but I have not been able to see their upper end. Between the cystogeneous cell-clusters and the excretory vessels a hyaline vessel was observed, ending near the excretory bladder. I suppose that these vessels or recurring canals belong to the excretory system, but neither branches of the second order nor vibratile tags have been observed. From the posterior part of the bladder issues a remarkably broad caudal vessel ending halfway; lateral canals have not been seen. Behind the ventral sucker was found a group of circular cells most probably belonging to the genital organ of the adults. The transversal musculature of the tail is very conspicuous; the interior is filled with parenchymatous cells with conspicuous nuclei.

The young Rediae are elongate with a small pharynx and an inconspicuous collar, and have faintly developed posterior locomotoric appendages. The intestine extends almost halfway (Pl. V, fig. 6); the posterior part is packed with germ-balls. The full-grown Redia is rather clumsy with a conspicuous collar, small appendages and the intestine not extending more than halfway of the length of the body. —

Host: *Bithynia tentaculata,* Ramløse Aa. 13/VII 31.

The snail showed a few Cercariae whose large size immediately struck me. Upon dissection, the snail was seen to be strongly infected. The Cercaria encysted under the microscope and similar cysts were found in the snail.

I cannot see that this peculiar Cercaria has been described hitherto.

Cercaria sp. Host: *Bithynia tentaculata.*

Pl. VI, figs. 9—11.

Rediae.

	Living	Preserved
Length of body	305	430
Breadth of body	180	185
Pharynx	90	85

In a little pond in the royal Park at Frederiksborg, of 9 *Bithynia* which were all infected with *Cercaria virgulae,* one had a double infection, containing also very peculiar Rediae of a Gymnocephale. They were only present in a number of 10—15; they were extremely clumsy, very irregular; the pharynx was extremely small; the collar very little developed, and so also were the posterior locomotoric appendages. The intestine is extraordinarily large, often filling almost the whole animal; it is mottled and of a peculiar greyish colour. A birth pore exists. The posterior part contains an enormous mass of small germ-balls, and some Rediae. These small Rediae (Pl. VI, fig. 11) are also found free in the liver; they have a relatively larger pharynx, and it can be shown that the pharynx does not increase in size during life; a collar is rather conspicuous, and sometimes there are faintly developed posterior locomotoric organs. The whole interior is occupied by an enormous intestine as broad as the Redia itself. Posteriorly in the middle line is seen a circular opening, which I suppose belongs to the excretory system.

I do not know to which *Cercaria* this peculiar Redia belongs. Because of the interesting stage (fig. 11) I think it worthy of mention. As I find it quite useless to make new species only upon the Redia stage, it has got no name.

Cercaria obscura n. sp.

Cercaria helvetica XVII Dubois. Host: *Bithynia tentaculata.*

Pl. V, figs. 7—8. Pl. VI, figs. 1—5.

The dimensions are:

Cercariae.

	Living
Length of body	240
Breadth of body	60
Length of tail	280
Breadth of tail	65
Anterior sucker	45
Ventral sucker	30

Rediae.

Length of body	410
Breadth of body	225

The Cercaria is very dark, the body almost black, and very intransparent. It is extremely variable in form. The tail may be longer than the body, and a few moments later much shorter (Pl. V, figs. 7—8); even when fully extended, it is often broader than the body, and when contracted, of a peculiar broad flattened shape, not tapering at the apex but almost as broad at the apex as where it is fastened to the body. When extended it seems to be dentated along the sides. In reality there is a small fin membrane, most conspicuous when the tail is contracted. The oral sucker is rather small, but a little broader than the ventral one. The latter is placed very near the posterior border of the body, so near that at the first glance it seemed justifiable to refer the Cercaria to the Amphistomes with which, however, it would not appear to be related on any point. The structure of the ventral sucker differs also from that of the Amphistomes; this is especially so with regard to size. — Of the alimentary canal only an oesophagus and the very inconspicuous pharynx have been seen. Behind the oral sucker lies a cluster of unicellular pear-shaped glands with distinct nuclei. Of the excretory system only the two broad excretory canals were observed. They were filled with oblong granules. When the body is fully extended (Pl. V, fig. 8) they lie on a line; when the body is contracted, the canals are much broader, and the granules lie side by side. The excretory canals taper in front and behind, and open in the bladder, which is divided into two parts; the one situated in the body being broad and flat, the other, almost heart-shaped, lying in the tail. From this part there issues a tubule running through the whole length of the tail. Of the rest of the excretory system nothing was seen. Peculiar small circular spots are seen regularly distributed through the tail. The whole body is packed with cystogeneous cells containing rod-like granules, and moreover so strongly pigmented that in the living state it is almost black.

The young Redia (Pl. VI, fig. 1) is of a long band-like form with a well-developed large sucker and a long intestine reaching the posterior locomotoric appendages. Behind them is a tail-shaped part, terminating in an organ which very much resembles a "holdfast" organ. In this stage the Rediae are extremely mobile. When they grow older, they are more clumsy; a collar is in evidence beneath the oral sucker, and the intestine is broader (Pl. VI, fig. 2). Finally, the Redia acquires a very clumsy form, a collar is not conspicuous, and posterior locomotoric appendages are not observed. The intestine is a very broad sack filled with food (Pl. VI, fig. 3). — I have not found Rediae producing Rediae; they have only contained Cercariae in great number. — One rather small Redia contained a large Tetracotyle (Pl. VI, fig. 4) which distended the Redia very much. — The development of the Cercariae takes place in the Redia, not outside in the tissues of the snail as is the case with the Amphistomata. The Cercariae seem to be bottom swimmers; the swimming motion is very peculiar. They always swim sideways; the body is strongly contracted and the broad tail is moved sideways. They do not especially favour the lighted side of the vessel. The sight of these broad flattened Cercariae moving over the bottom in a very characteristic lazy manner, is very peculiar; by the motion alone the Cercariae may be distinguished at the first glance (Pl. VI, fig. 5). — Encystation has not been observed.

This very peculiar form was only found once on 16/IX 31 in a bay of the Furesø. The host is *Bithynia tentaculata*. Of 120 specimens 7 were infected. —

I refer this form with some doubt to *Cercaria helvetica XVII* Dubois; but I find it so characteristic that it must have a normal systematic name; — Dubois has found a series of small bristes on "la lèvre dorsale de l'ouverture buccale" (1929, p. 38); they have perhaps been overlooked by me.

In 1931 Petersen (p. 24) described a Cercaria which he regards as an Amphistome. The host is *Bithynia tentaculata*. Of all hitherto described species this seems the most nearly related to mine; the form of the tail appears to be the same; the double excretory bladder has the same form and place, and the ventral sucker lies very near the posterior border. There is a cluster of small cells behind the oral sucker. Of the excretory system the two main canals with a series of granules were observed. The alimentary canal seems to be very peculiar. There is an oesophagus which terminates in a well-developed pharynx, but the two long intestinal diverticula which almost reach the posterior margin of the body branch off before and not behind the pharynx. As far as I know, this structure is unique among Cercariae. It develops in Rediae; the tail seems to be much shorter than in my specimen. The Cercaria differs from mine by the absence of pigment. —

In spite of the differences I am inclined to think that it is PETERSEN's form which I have had before me. The place of the Cercaria is doubtful. The position of the ventral sucker is the same as in the Amphistomes, but on all essential points, especially with regard to the excretory system, it differs from these. I regard it as an aberrant form of the Gymnocephalae; if DUBOIS' form is the same as mine he has arrived at the same conclusion. His form was also found in *Bithynia tentaculata.*

Cercaria lophocerca FIL. Host: *Bithynia tentaculata.*

Pl. VI, figs. 6—8.

The dimensions are:

Cercariae.

	Living	Preserved
Length of body	730	181—242
Breadth of body	180	85—133
Length of tail	1160	315—600
Breadth of tail	170	28—40
Anterior sucker	105	31—42
Ventral sucker	..	..

Rediae.

Length of body	2030	..
Breadth of body	80	..
Pharynx	45	..

The body is slenderer than that of the hitherto mentioned species of Gymnocephala from which it differs very much on all essential points.

The Cercaria is of a yellow colour owing to a yellow pigment not arranged in lines, but forming a network over the whole body and giving it a mottled aspect. The forepart of the body is covered with very small spinosities. It is very opaque owing to the large amount of cystogeneous cells filling almost the whole body, and every cell is packed with granules. The oral sucker is well-developed and is followed by a short prepharynx, a pharynx, and a short rod-like gut reaching a little behind the eyes. I have not been able to see the slightest trace of intestinal diverticula. There are two eyes; their structure is in accordance with the description given by DUBOIS (1929, p. 36). A very peculiar feature is the ventral sucker, most conspicuous in young animals, but almost obliterated in older ones. The sucker may be found at all stages of the development. Most probably it has no practical significance for the animal itself, but from a theoretical point of view it is very interesting to find a rudimentary ventral sucker in a gymnocephalous Cercaria, especially when it can be shown that it is best developed in the young animal, and then becomes obliterated during the course of its life. Round the sucker are observed some large cells with a dark content. I suppose that these are the cells which DUBOIS (1929, p. 34. Pl. 15, fig. 95) regards as penetration glands, and whose ducts have been observed by him near the oral sucker. Of the excretory system the bladder is remarkably large with thick walls. From the anterior corner issue two excretory vessels which bend outward near the region of the eyes. They are difficult to observe, especially because they are not packed with granules. Vibratile tags have not been observed; Dubois maintains that he has seen five pairs. From the bladder a posterior duct passes downwards through the tail. The tail is very long and furnished with a finfold, very broad at the posterior end, but also developed along the borders of the whole tail. It is difficult to observe, and either of very varying development in the different species, or differently developed at the different ages of the animal. In young animals it seems to be wholly lacking.

The Cercariae are developed in extremely long, band-like, very irregular Rediae, which are often peculiarly knotty. The pharynx is small and the intestine only about twice or three times the length of the pharynx. The whole sack is filled with brood, but in all observed species only in the shape of germ-balls; Cercariae have never been observed. They seem to leave the Rediae at a very early stage of development.

The host is *Bithynia tentaculata.*

It seems to be a rare form everywhere, being only observed occasionally, the first time by Filippi (1859, p. 203), and later on only by Dubois (1929, p. 36). In Denmark I have only found it in one locality, a small bay of the Susaa near its outflow into Tjustrup Lake. *Bithynia* is rare here; of four specimens it was found in one. The snail showed no Cercariae when alive; they were only found after dissection. I do not think that the Cercariae were quite ripe; at any rate encystment was not observed. The liver was packed with Cercariae and contained many of the very long Rediae.

It is a question if I have not had before me the insufficiently described species of Ercolani: *C. fulvopunctata.* Lühe (1909, p. 186) refers it to the Gymnocephala, saying that the ventral sucker is "nicht immer deutlich". It is very inadequately described; it agrees with my species in the development of the fin membrane through the whole length of the tail. This is also the case with *C. lophocerca* Fil. though Dubois (1929, p. 142) says that *C. fulvopunctata* differs from *C. lophocerca* Fil. "par la présence d'une membrane ondulante sur toute la longueur de la queue". It is furthermore nearly related to *C. Indicæ* VII (Sewell 1922, p. 25) which belongs to the *Pleurolophocerca* group and which Sewell refers to the Monostomes.

Biological Remarks.

In my experience, the following points are characteristic of the biology of the gymnocephalus Cercariae.

1. The are all bad swimmers; they live near the bottom and seem to have no special predilection for light.

2. One of them, at any rate, viz. *C. Fasciolae hepaticae,* seems able to content itself with very little water, perhaps only the morning dew. The life of the Cercaria

is extremely short in its free-swimming stage, normally some hours, often perhaps only some minutes. —

3. Apart from *C. Fasciolae hepaticae* most of the other Gymnocephalae show a peculiar predilection for prosobranchiate snails; their hosts are almost always *Bithynia* and *Paludina*. In Europe few are recorded from *Limnaea* (*C. fallax* Pagenstecker, *C. agilis* Fil. and *C. neglecta* (Fil.); the two last-named have only been found once and only in a single locality).

4. The rule is that encystation takes place in the open. The facts hitherto recorded show that there is no secondary host; the cysts are transferred directly to the final host when the latter feeds on plants etc. on which encystation has taken place.

5. In the encystment stage the cysts are able to withstand desiccation for a long time; according to Mathias (1925, p. 94) *Cercaria tuberculata*, the Cercaria of *Psilotrema spiculigerum* Mühling, will endure desiccation for at least 40 days. — Nöller (1928, p. 159) has shown that the cysts of *Fasciola hepatica*, upon complete drying of the hay, cannot endure a period of desiccation of 44 days; in nature, where desiccation is not complete, they may preserve their vitality much longer. The first-mentioned result is of great practical significance, because it has been alleged that sheep could get liver flukes by eating old hay which had been stored in barns for winter fodder.

6. In some cases encystation seems to take place in snails. Creeping gymnocephalous Cercariae without a tail have more than once been found in snails which contain no Rediae, and in which it may be supposed that the Cercariae have made their way into the snail to encyst. Several times Cercariae were also observed to encyst almost the moment the fluids of the snail came into contact with water. Further, in some snails I found cysts which contained larvae without collar spines and without xiphidioid stylet, and which I have been inclined to refer to the Gymnocephala. —

Chapter IV.

Echinostomata.

Cort (1915 a, p. 36) maintains that it is impossible to subdivide the Echinostomes into smaller natural groups, and Dubois (1929, p. 43) adopts the same view; from my own studies I feel inclined to agree with them. Sewell has tried to divide the echinostome Cercariae into the following four groups.

1. The *echinatoides* group.	*C. echinatoides* Fil. = *C. echinifera* La Val. *C. spinifera* La Val. *C. Indicae* XLVIII.
2. The *coronata* group.	*C. echinata* = *C. Echinostomi revoluti.* Frölich. *C. indicae* XX. *C. coronata* Fil.

3. The *echinata* group.	*C. trivolvis* Cort. *C. indicae* XII. *C. indicae* XXIII.
4. The *megalura* group.	*C. distomatosa* Sonsino. *C. megalura* Cort. *C.* sp. Lutz. *C. indicae* IV.

If I were to subdivide the Danish echinostome Cercariae here studied in accordance with the views of Sewell, we should arrive at the following results:

1. The *echinatoides* group.	*C. echinatoides* Fil., host *Paludina vivipara.* *C. spinifera* La Val., host *Planorbis corneus.* *C. echinostomi* Dubois, host *Limnaea palustris.* *C. abyssicola* n. sp., host *Valvata piscinalis.*
2. The *coronata* group.	*C. Echinoparyphii recurvatae* Matth., host *Planorbis umbilicatus.* *C. affinis* n. sp. *Limnaea auricularia.*
3. The *echinata* group.	*C. echinata* Sieb. = *C. Echinostomi revoluti,* host *Limnaea stagnalis.* *C. hypodereae conoideae* Matth., host *Limnaea ovata.*
4. The *megalura* group.	Not represented.

The correctness of referring *C. affinis* n. sp. to the *coronata* group is doubtful; the Rediae having a very long and not a very short intestine. —

Cercaria echinatoides Fil. Host: *Paludina vivipara.*

Pl. VII, figs. 1—2.

Rediae.

	Living
Length of body	2510
Breadth of body	710
Oral sucker	180

As stated above, *C. echinatoides* was found in *Paludina vivipara* in a very small shallow pond at Hellebæk near the Sound. Though I have opened more than one hundred specimens from all seasons of the year, apart from a single individual I only found cysts (207—216 μ). On 2/II 32, out of 10 specimens only one contained Rediae with Cercariae which were not quite ripe. —

Paludina vivipara is a rather rare animal in our country, but is not uncommon in most of the lakes which give water to the Susaa, and in the Susaa itself. Many specimens from these parts have been studied in the summer months, but no Echinostomes were found here.

In spite of the fact that I have seen no ripe *C. echinatoides,* I feel convinced that it is this species with which I have had to do. On opening the cysts, it could clearly be seen that the number of collar spines was more than forty, and that there were four ventral and lateral spines which were much larger than the dorsal ones. Pl. VII fig. 1. The large spines are also very conspicuous through the wall of the unhurt cyst.

As far as I know, none of the other European echinostome Cercariae show such a conspicuous difference between the dorsal and ventral spines. As I have never seen fully ripe Cercariae, the fin round the tail was not fully developed. — In addition, the structure seemed to agree in all respects with *C. echinatoides.* The Redia is colourless, transparent; the pharynx is remarkably small, but the intestine is very well developed; it almost reaches the posterior wall and is conspicuously sinuous. It always contains food of a pale yellowish colour and filled with a number of small grains. There are two rather small posterior locomotoric appendages, often withdrawn. The number of Cercariae contained in the Rediae was not large, rarely more than four to six.

Cercaria Echinostomi Dubois. Host: *Limnaea palustris.*

Pl. VII, figs. 3—4.

The dimensions are:

Cercariae.

	Living	Preserved
Length of body	840	..
Breadth of body	475	..
Length of tail	670	..
Breadth of tail	155	..
Oral sucker	115	..
Ventral sucker	130	..

Rediae.

Length of body	3400	2108—3240
Breadth of body	500	424—498
Oral sucker	160	53—88

This is the largest echinostome Cercaria I have seen. The body is rather broad, with a slight constriction behind the collar. The oral sucker is a little smaller than the ventral one; this is situated a little behind the transversal middle line of the body. The number of collar spines is about 35; they are almost of the same size; the dorsal spines are arranged in two rows. The powerful very muscular tail is provided with a fin membrane broad in the posterior part of the tail, and very narrow anteriorly; the tail itself is remarkably broad and flat. The digestive system is unusually narrow in all its parts. The pharynx is small; the oesophagus is very long, it almost reaches the ventral sucker. The two diverticula reach the bladder. In their course they form a peculiar elbow, just in the middle line of the ventral sucker. The oesophagus is filled with an uninterrupted line of rectangular refractive bodies, which likewise occur in the first part of the diverticula; the last part is filled with diminutive granules differing in size and irregularly arranged. The whole body is packed with cystogeneous cells. The excretory bladder is rectangular; the narrow ascending tubules, on reaching the ventral sucker, form there a peculiar loop inwards, highly characteristic of the animal; between the ventral and oral suckers the tubules are much broader, and here packed with small granules, not present in the other part of the system. On reaching the collar, they form the normal loop for echinostome Cercariae, and the descending tubules follow the ascending ones on their outer side. Arrived at the ventral sucker, they divide, sending out one anterior and one posterior branch. I think I have seen this with certainty and suppose therefore that Sewell (1922, p. 112) is correct when he in contradistinction to Dubois (1929, p. 42) maintains that the vessels at the level of the acetabulum in the Echinatoides group divide into anterior and posterior collecting tubes. The anterior branch makes a large loop on a level with the ventral sucker; these two branches are provided internally with a long row of ciliated patches presumably flame cells, about 25. The branches carry branches of the second order which again carry the vibratile tags, two of which are seen near the ventral sucker, two or three are seen inconspicuously near the bladder. The others have not been seen with certainty. Posteriorly the bladder gives off a tubule running through the tail, and giving off two lateral branches in the first third of it.

The large Rediae (Pl. VII, fig. 4) are of a regular rod-like form; a collar is faintly developed, and so are the posterior locomotoric appendages. The pharynx is rather small, and the intestine long, commonly reaching the appendages. The Redia contains very many germ-balls, but of ripe Cercariae as a rule not more than 4 to 6.

This very peculiar form is found in *Limnaea palustris*. There can be no doubt that we are here concerned with *C. Echinostomi* sp. *de Fulica atra* described by Dubois (1929, p. 45). Originally I had determined the species as *Cercaria limbifera* Seifert (1926, p. 112) and was inclined to suppose that the two species were identical. Seifert's species was redescribed by Brown (1931, p. 91), and especially after this description I feel convinced that these two species, if not identical, are at all events very closely related to each other.

C. Echinostomi was originally found on 1/VIII, later on 20/X in *L. palustris* on the banks of Bromme Lake near Sorø, in one specimen out of 20. In 10 specimens gathered on 20/X, 31, none were found. Of 10 snails from the banks of Tjustrup Lake, 2 specimens were infected. In small ponds near the borders of Furesø (30/IV, 32) the infection was stronger. Of 25, 6 were infected and of 5 from 14/V, 3. These snails were strongly infected, nevertheless the number of Cercariae thrown out was but small, only 4 to 6 a day. They were also found in specimens from Bagsværd Lake on 30/VI, 32 (in 1 of 4 specimens), and from Fønstrup Pond on 30/VI, 32 (in 1 of 5 specimens). This species seems, therefore, to be rather common and strictly limited to *Limnaea palustris*. In all the above-named localities *Limnaea stagnalis* and *L. ovata* were lying side by side with *L. palustris*. But nevertheless *C. Echinostomi* was never found in the former two species; on the other hand, these would harbour other echinostome Cercariae which did not occur in *L. palustris*. —

Cercaria abyssicola n. sp. Host: *Valvata piscinalis.*

Pl. VII, figs. 5—7.

The dimensions are:

Cercariae.

	Living
Length of body	360
Breadth of body	170
Length of tail	310
Breadth of tail	55
Oral sucker	55
Ventral sucker	80

The body is elongate with a slight constriction behind the collar; the oral sucker is smaller than the ventral one which is situated in the posterior third of the body. There is a circlet of collar spines which are all nearly the same small size. Their number is about 30. The powerful, very muscular tail is provided with a fin membrane only developed on one side. It is broad at the apex of the tail, but passes as a small membrane to the point of attachment of the tail to the body (Pl. VIII, fig. 6). When the tail is seen laterally, the membrane is seen as an undulating band. I have been unable to see any part of it on the other side of the tail. — The digestive system consists of a rather long prepharynx, a well-developed pharynx and a long oesophagus. The oesophagus almost reaches the ventral sucker, and the two long diverticula extend to the bladder. They are filled with a series of large hyaline globules, numbering about 10 in the oesophagus, and 12—15 in the diverticula. The cystogeneous cells fill almost the whole body cavity; they have a granular structure which makes it very difficult to see the excretory system. The bladder is rather large, almost quadrangular, giving off two anterior canals which pass the ventral sucker as very thin tubules, but are much broader anteriorly to the oral sucker and contain numerous small granules, the biggest of them lying in the broadest part of the tubules. They are tripartite with two lines. Near the pharynx the tubules attenuate again and form the loop characteristic of all echinostome Cercariae. Then the tubules bend downwards again, following the outer side of the tubules. Near the broadest part of the ascending tubules a branch running anteriorly is given off. Flame-cells have been observed along these branches, but I have been unable to give a trustworthy sketch of their number and position. Posteriorly the bladder gives off a tubule which runs through one-third of the length of the tail; the lateral canals have not been observed.

The Redia has a well-developed pharynx and an intestine which almost reaches the posterior locomotoric appendages. The latter are small and almost invisible in older Cercariae. When old, the Redia is very clumsy; the appendages entirely disappear; the gut is very broad and has a mottled aspect. In one of the Rediae (Pl. VII, fig. 7) I saw the excretory system very clearly. It consisted of a canal running from the pharynx almost to the middle of the body where it divided into two diverging branches almost reaching the posterior end of the body. — In one of the snails there were about 100 cysts round the heart; specimens were found which had thrown off the tail and were in process of encystment; the snail contained 2—6 Cercariae. The cyst has a broad hyaline outer part; then follows a small inner part and then the larva itself. This species has only been found once in three specimens out of 80 taken by dredging at a depth of 7 m. in Tjustrup Lake. —

As far as I know, no echinostome Cercaria has been recorded from *Valvata piscinalis*. Of all hitherto known echinostome Cercariae it seems nearest to *C. echinatoides* from *Paludina vivipara*. It differs from it mainly by the remarkable course of the fin membrane of the tail.

Cercaria Echinoparyphii recurvati. Mathias. Host: *Planorbis umbilicatus.*

Pl. VIII, figs. 1—8.

Cercariae.

	Living	Preserved
Length of body	440	197—250
Breadth of body	240	128—132
Length of tail	430	312—377
Breadth of tail	70	47—54
Oral sucker	60	42—47
Ventral sucker	70	39—46

Rediae.

	Living	Preserved
Length of body	2510	1203—2122
Breadth of body	360	221—240
Pharynx medium	80	46—60

The Cercaria is of medium size, ovoid, elongate, and with the normal collar of echinostome Cercariae. The collar spines are all nearly the same size; their number is about 45. The oral sucker is a little smaller than the ventral one; this is situated a little behind the middle line of the body. The tail has no membrane. The cystogeneous cells fill almost the whole body; the internal structure of the Cercaria is therefore very difficult to make out. The oesophagus reaches the ventral sucker and is provided with a pharynx; the two diverticula reach the bladder. The oesophagus is occupied by a series of large hyaline globules in a number of 10—15. In the diverticula they are only conspicuous in the part nearest the oesophagus. The bladder is rectangular or ovoid; it gives off two anterior tubules which are very thin till they reach the ventral sucker when they bend outward and show a considerable increase in breadth; in this part they are packed with granules. They then form the normal loop of echinostome Cercariae and pass back at the outer side. The rest of their course has not been observed with certainty. Posteriorly the bladder sends off a tubule passing in the middle line of the tail and giving off two lateral branches in the anterior third of the tail. Vibratile tags have not been seen.

The Redia (Pl. VIII, fig. 2) has a rather small pharynx, a well-developed collar, and two faintly developed lateral locomotoric appendages. The intestine is very short, almost always filled with a black content; in very young (newly born) Rediae (Pl. VIII, fig. 4—5) the appendages are much more conspicuous. The number of ripe Cercariae is only rarely more than 4—6; when young, the Redia is very mobile; when old, almost motionless. *Cercaria Echinoparyphii recurvati* Mathias is found in *Planorbis umbilicatus.* It agrees in all essential particulars with those described by Mathias, only the spines arranged in transversal rows over the whole body have not been observed, perhaps because I have overlooked them. — It would appear to be related to *C. equispinosa.* Brown (1926, p. 26).

The species has been found in the following localities.

	Number of specimens examined	Infested specimens
A moor near Hillerød 12/II, 32	30	1
The banks of the Furesø 3/V, 32	40	7
Grønnegade, near Hillerød 2/VI, 32	50	50
30/VII, 32, 75 of 100		
Hørsholm, ponds 8/VII, 32	3	3
Regnstrup, Sorø 11/VIII, 32	100	10

The species seems to be rather common; in one of the ponds, Grønnegade, almost every species was infected and the infection was heavy. The snails produced about 50—100 Cercariae every day. The normal free-living period is very brief. Encystation never takes place in the open. Either the Cercariae die in the course of 24 hours, or they enter another snail if not the same in which they have been developed. In a specimen taken on 12/II from a moor near Hillerød the whole liver consisted almost entirely of cysts, and in addition there were about 100 Rediae, all very old, and only containing one or two Cercariae. These Rediae adhered to the outside of the liver, and were quite motionless. Among the cysts were found several Cercariae, some of them without a tail. Some had only a single, others a double contour. Of 10 snails only one had Cercariae and cysts. From these observations I feel inclined to suppose that the hibernation takes place in the snail itself. That the Cercariae should leave the snails at temperatures near zero seems to me highly improbable. The cysts are drawn, Pl. VIII, fig. 6—8.

Cercaria spinifera. La Val. Host: *Planorbis corneus.*

Pl. VIII, figs. 9—17. Microphoto Pl. XXXVIII, fig. 14 and fig. 17.

The dimensions are:

Cercariae.

	Living	Preserved
Length of body	370	173—188
Breadth of body	245	117—176
Length of tail	570	279—358
Breadth of tail	65	24—33
Oral sucker	50	23—50
Ventral sucker	70	31—48

Rediae.

	Living	Preserved
Length of body	1190	900—1400
Breadth of body	270	249—297
Pharynx	70	27—63

The form of the body is oblong, ovoid, with a slight constriction behind the collar. The collar spines are 40—45, all approximately of the same size. The oral and the ventral sucker are nearly the same size, the last-named situated a little behind the middle line of the body. The cystogeneous cells are arranged in two large clusters on either side of the middle line; all the cells are packed with short, rod-like bodies. Just in front of the oral sucker, on the anterior edge, are seen six small tips, which might be points for glands, but neither such nor ducts have been observed. The long oesophagus is furnished with a pharynx and reaches the ventral sucker; the two diverticula reach the bladder. The latter is broad and often assumes a rather flat form. The course of the anterior excretory canals is in accordance with that described for *C. Echinoparyphii recurvati;* the part between the ventral sucker and the collar is very broad and filled with small granules, the course of the vessels in the posterior part of the body I have not been able to see with certainty. — The posterior excretory canal through the tail gives off near the base two small lateral branches. —

The tail has a well-developed fin membrane, which seems to be subject to great individual variation. It may reach the body and it may be of differing extension on the two sides of the tail. In some specimens (those from Torkeris Pond) the tail terminates in a long tip without a fin membrane. One of these specimens has been drawn.

The species was chiefly studied in Torkeris Pond, and material was gathered almost at all times of the year. From this locality alone 220 *Planorbis corneus* were opened and the parasite was found in every specimen. In most of them cysts were found, often forming a great lump in the wall of the lung just above the heart (Pl. VIII, fig. 17).

It is a question whether all these cysts, which may be present by thousands, really belong to this species. They have, in addition, been found in the following localities.

Locality	Number of specimens examined	Infested specimens
Donse 8/VII, 31	100	3
The moor near Hillerød 14/VII and 30/I, 32	190	11
Susaa, Sorø 3/VIII, 31	1	1
Strødam 27/IV, 32	5	5
A pond near Faurholm Kehus. 8/V, 32	6	6
A pond near Steenstrup, Sorø 11/VIII, 32	25	25
The Castle Park, Frederiksborg 1/VIII, 32	5	1

Investigations from Torkeris Pond show that the Rediae are present all the winter, but the production of Cercariae is but small. In the summer the Rediae produce Rediae as well as Cercariae, but mainly Cercariae. A single snail may produce several hundreds on a warm summer day. After 24 hours most of the Cercariae lie as a white layer at the bottom; encystation outside the snail was never observed. They are relatively slow swimmers, and like all echinostome Cercariae they are never found suspended in the water. They mostly swim near the bottom, and are not positively phototactic. Most probably they make their way into the snails again, but their actual entrance into the snail has not been observed. —

The species is generally most easily recognisable in the Redia stage. The Redia is commonly orange-coloured; the pharynx is small, the collar and a birthpore are very conspicuous. In young specimens the posterior locomotoric appendages are very much in evidence, in the older ones they may often be almost obliterated. A highly characteristic feature is the extremely short gut; often it is not more than three times the length of the pharynx; its contents are always black, and when the snail is opened, all the orange-coloured worms with the black spot visible with the naked eye, are observed. The whole interior of the Redia is packed with germ-balls, daughter rediae, Cercariae, Tetracotyle, and now and then echinostome cysts; almost ripe Cercariae may be present in a number of 12. The young Rediae are very mobile, the old ones, almost motionless.

Cercaria echinata. Sieb. Host: *Limnaea stagnalis.*

Pl. IX, figs. 1—13. Pl. X, figs. 1—14. Microphoto Pl. XXXVIII, fig. 15.

The dimensions are:

Cercariae.

	Living	Preserved
Length of body	800	664—682
Breadth of body	350	295—332

	Living	Preserved
Length of tail	700	540—614
Breadth of tail	110	101—111
Oral sucker	60	60—88
Ventral sucker	145	106—120

Rediae.

Length of body	4010	1620—2942
Breadth of body	750	318—682
Pharynx	450	189—231

Cysts.

		229—268

The Cercaria is large, commonly with a well-defined constriction behind the collar. The number of collar spines is about 40, most probably 37, all almost of the same size, but eight on the inner edge of the lappets a little larger. They are arranged in two alternate rows; as Johnson points out for the Cercaria of *Echinostoma revolutum*, they are not fully developed until the Cercariae have left the Redia; and even in free-swimming Cercariae they may seemingly be very little developed. The skin has a peculiar warty aspect. The oral sucker is smaller than the ventral one, and the latter has often a more oblong form; it lies a little behind the middle line. The mouth opening carries a row of small processes at its lower edge. Brown (1926, p. 123) has found 12 openings round the mouth; they are openings for 12 ducts leading from gland cells distributed throughout the anterior region of the body and obscured by overlying cystogeneous glands. The anterior part of the body is extremely variable in form, rounded, or with a more pointed part set off from the broad collar, behind which a constriction between it and the rest of the body is plainly visible. The whole body from the pharynx to behind the ventral sucker is packed with cystogeneous cells, which make the study of all organs very difficult. In many respects the young Cercariae in the Redia are better suited for study than free-living ones, the latter getting darker and darker every hour. The cells are packed with matter destined for the formation of the cysts, and present in the shape of short rod-like bodies. No ducts were observed. The oesophagus is long and almost reaches the ventral sucker. It is provided with a little pharynx. The two diverticula reach the base of the bladder. The oesophagus is filled with a series of large refractive bodies, very conspicuous and arranged in one or two rows, their number being 22—30. All these bodies make the whole alimentary canal extremely conspicuous, more so, as far as I know, than in any other Cercaria that has been described. The large bodies may also in some specimens occupy the lateral parts of the diverticula. The most posterior parts nearest the bladder are always packed with very small granules. —

The excretory system fully agrees with that carefully described by JOHNSON (1920, p. 348) for the Cercaria of *Echinostoma revolutum*. Like JOHNSON I have seen the bladder divided into an anterior smaller muscular, and a posterior much larger more hyaline part. The anterior part regularly disappears, whereupon the posterior part increases in size. Then the whole bladder disappears again; slowly the posterior part begins to be filled up, and when expansion has reached its highest point, and the bladder has got a quadrangular form, the anterior part is visible. The bladder gives off two anterior tortuous tubules (the muscular descending tubes of Johnson); arrived at the middle of the ventral sucker, they bend outwards. From here to the pharyngeal region they are widely dilated and filled with refractive excretory granules. As always in the echinostome Cercariae, these granules are only formed in this part of the excretory system. They are smallest nearest the pharyngeal region; then they grow larger and then usually smaller again nearer the ventral sucker. They may be formed in this very part of the tubules, but presumably they are again dissolved, for real granules are neither seen in the part of the tubules near the bladder nor in the bladder itself. Near the oral sucker the tubules form the loop characteristic of the excretory system of all echinostome Cercariae, and next turn backwards following the dilated portions on their outer side. Arrived at the bladder, they again run forwards. I have been unable to follow the tubules of the second order which carry the flame cells, nor have I been able to see the manner in which these are connected with the tubules. The flame cells are drawn where I have seen them. The bladder gives off a posterior excretory tubule, running through the tail and giving off two small lateral canals rather near the attachment of the tail to the body. In one of my preparations with a lateral view of the tail, the tubules terminate quite distinctly at the place from which the lateral canals issue. — The tail is almost of the same length as the body or even longer; there is no fin membrane. Beneath the fine cuticula there is a layer of circular muscle fibres, and below this again follows a layer of longitudinal ones. The circular muscle fibres appear in optical section as a linear series of fine refractive dots. The tail further contains parenchymatous cells with numerous round nuclei, scattered everywhere but most numerous nearest the base of the tail. — The young Redia (Pl. X, figs. 1—2) is a very slender, extremely mobile little creature. It is very hyaline. After the pharynx, always well-developed, follows a short intestine. The collar is very conspicuous and the whole part before the collar always in constant motion; the pharynx is incessantly pushed forward and again retracted; simultaneously the collar is now contracted, now expanded. From the collar to the intestine there passes a series of muscle threads; a birth pore is not visible in these newly born individuals. The intestine itself is a thin, rod-like body. The posterior locomotoric appendages are remarkably long, often projecting perpendicularly from the body (Pl. X, fig. 3). In the interior are seen 20—40 germ-balls, globular or oblong, already present before the daughter Rediae leave the mother (Pl. X, fig. 6). The full-grown Redia differs in appearance; it is much broader, and not so mobile; the intestine has not kept pace with the growth of the whole body and is often only $^1/_5$ to $^1/_6$ of the total length; the appendages are not so conspicuous, and a birth pore is always present though not always visible. In many cases the excretory organ is plainly visible, lying round and near the posterior locomotoric appendages. Branches ending in flame cells were often observed (Pl. X, fig. 5); they are even conspicuous in some of my slides. The whole interior is packed with enormous masses of brood, first Rediae and later on Cercariae (Pl. IX, fig. 12). Very often Rediae and Cercariae are present simultaneously. It is difficult to decide how many generations of daughter Rediae are produced, and it is perhaps doubtful whether all Rediae pass through both a Redia and a Cercaria-producing stage, but that they contain Rediae and Cercariae simultaneously is certain. Where this is the case, I have often seen daughter Rediae in the mother Redia devouring either other daughter Rediae or young Cercariae, but I have never seen Cercariae do so; the Cercariae of Echinostomes are only nourished endosmotically. —

The part behind the appendages may be filled with germ-balls; nearer the pharynx are found the fully-developed Cercariae. Their number is rarely more than 12, often only 4—6; a time comes when all the germ-balls are developed into Cercariae, then the Rediae pass into the last stage; no more Cercariae are produced. The colour has changed from hyaline through yellow to brown or almost black. They are now motionless, only the forepart may move a little; the posterior locomotoric appendages are no longer visible, and the form of the whole animal is extremely irregular. Pl. IX, figs. 3—4 and 6—10 shows some of these peculiar forms. They are empty, or contain a few Cercariae, fully developed, motionless, most probably dead. In two cases I found two or three echinostome cysts in the Redia; this has also been found by Johnson (1920, p. 362) who has found 58 Rediae with cysts inside. It is not certain whether they belonged to Cercariae developed in the Redia, or to Cercariae which had passed in through the walls of the Redia from without. I regard the first supposition as the most probable, but there is no doubt that we are here concerned with rare exceptions.

In no other Redia have I found so many Tetracotyle as in this species. They occurred in the free, creeping stages as well as in the encysted stage. Snails are found in which almost every full-grown Redia contained Tetracotyle; a number of 10—12 in a single Redia is not uncommon. Pl. X Fig. 4 shows a Redia with six Tetracotyle surrounded by Cercaria brood. When the Rediae grow old and the Cercaria production ceases, they still contain the Tetracotyle. The Redia shrivels between the Tetracotyle, and is changed into a string of "pearls". That these Tetracotyle originate from Furcocercariae which have pierced the skin of the Redia is of course beyond doubt. The highly irregular forms of the old Redia are often due to Tetracotyle stages.

As mentioned above, cysts were often found in the snails and the process of encystation was directly observed. There can be no doubt that encystation may take place in the snail without any free-swimming period, especially under unfavourable life conditions when the snail is almost exhausted, or at low temperatures. —

As is well known, the production of Cercariae is mainly restricted to the summer months. In so far as the Trematoda use the molluscs for hibernation, it is mainly as Rediae and as cysts that they occur here. —

The rule seems to be that the infection with Miracidia takes place in the summer months; then the production of Rediae sets in; in some cases Cercaria production takes place the same year. If the infection with Miracidia has begun at a relatively late period of the year, the Redia production goes on during the whole winter.

Regular observations relating to Echinostome infection of *Limnaea stagnalis* from Torkeris Pond, based on collections from 29/I, 22/IV, 29/IV, 25/V, 6/VII, 13/IX, 25/XI, show during the autumn, the snails so to speak abound with large yellow Rediae, containing and producing an enormous quantity of young Rediae. The whole intestinal sac of the snail almost seems to contain Rediae only; hardly any part is left of the sexual organs of the snail; the liver tissues are broken down, and the intestine is covered with a thick yellow coating of Rediae. Moreover, if the infection is very heavy, the Rediae are not only found here. Upon dissection it can be shown that the Rediae are lying in nests, spread over the whole mantle (especially observed on snails from Fortun Pond 16/IV, 32). When they are pricked with a needle, yellow masses of Rediae rush out. The snail begins the hibernation period surcharged with the parasite mainly in the Redia stage. Infection of this kind is almost only found in large snails of the oldest age-classes. Their shell is very fragile; the cuticula is broken off on large parts of the shell; the power of reparation with chalk is lowered, and often the shell has open holes through which the yellow Rediae are observed. The spire is almost always lost. During winter very many of these snails die and in that case all the endeavours of the parasites to reach maturity are destroyed at a blow. It is indeed highly remarkable that a good deal of these old heavily infected snails really are able to hibernate. This may, however, be the case, and in the last days of April and May the production of Cercariae in these old snails goes on, and enormous amounts are produced. Again the snails are used by the parasites for their purposes. As Cercariae after a brief period in the open they again enter the snails, but in my opinion not always *Limnaea stagnalis*. The heavy infection with echinostome cysts in *Planorbis corneus* lying side by side with *Limnaea stagnalis* in the same pond, and the absence of Redia infection in *Planorbis*, would seem to show that the Cercariae also encyst in *Planorbis*. Both contain enormous amount of cysts; the old *Limnaea* especially in the mantle, *Planorbis* mainly in the walls of the lung and in the pericardium. In early summer most of these old snails die, and the cysts are spread over the bottom and the margins of the ponds. A comparison with the observations on collections from other ponds during the winter months, especially from Strødam and Donse and from a pond near Clausens brick works would appear to warrant the following view. During autumn and winter the parasites concentrate all their efforts on increasing the Cercaria-producing material, i. e. the Rediae; the increase is greatest at falling temperatures in the autumn; during the winter the young daughter Rediae remain motionless in the mother Redia or support life by cannibalism; hence many of the large Rediae are relatively empty during early spring, containing only a few well-developed Rediae, while in the autumn they often contain several hundreds in all developmental stages. If the growth of the parasites is too strong, the snail succumbs. If not, when the temperature begins to rise after the period of frost is over, and the snails begin to feed eagerly at the borders of the ponds where the temperatures on the sunny days of early spring may rise to about 20 degrees, the production of Cercariae sets in.

It will be understood that during winter it is commonly impossible to see whether or not a snail is infected. Snails have been kept in aquaria at low temperatures; they have never shown Cercariae, but when dissected, an enormous Redia infection. On 26/IV one *L. stagnalis* was taken from a little pond near Hillerød; it died in the aquarium on 18/V, had never shown Cercariae, but, when dissected, showed enormous masses of Rediae containing Cercariae, not ripe. Another snail from the same pond and the same day was presumed to be infected owing to the yellow colour of the spire. It never showed Cercariae. On 19/V the tip of the spire was broken off, and out came a stream of Rediae. The hole was stopped with paraffin, but three days later the snail died. The Cercariae had left the Rediae; they were lying free in the tissues of the snail, but no encystation had taken place, undoubtedly because the cystogeneous apparatus of the Cercariae had not been fully developed. A third from the same pond and the same date gives the first Cercariae on 23/V. When dissected on 25/V it showed an enormous amount of Cercariae in the Redia, many in the snail itself, and cakes of cysts round the intestine near the lung cavity. Sooner or later in the course of the summer all these heavily infected snails died in the aquaria. They can hibernate in our aquaria, but we have been unable to keep them alive during summer. This is in accordance with the observations in nature. We have always had to do with the largest snails of the last age class, which is destined to die during the summer half of the year.

The development, however, does not always take the course given here. In some rare cases e. g. on 26/I 32 *Limnaea stagnalis* from Strødam showed a heavy infection. During the period 26/I to 24/II twelve snails were dissected. Three of them had shown echinostome Cercariae. These three and two others when dissected exhibited a strong Cercaria production. They had been kept in aquaria at temperatures of 12—17° C. This shows that the development of Cercariae may begin at low temperatures whereupon it stops during the winter and begins again when the temperature rises. The Cercariae are lying dormant in the snails the whole winter. It was in these very same snails that the process of encystation was observed mentioned pag. 64, which shows furthermore that at low temperatures the encystation may take place in the very same snail in which the development has begun.

Whereas I have been unable to find marked differences in the structure of the Cercariae of *Limnaea stagnalis*, the form of the Redia found in *Limnaea stagnalis*, the size of the pharynx, the intestine, and the posterior locomotoric appendages may differ considerably. This is the case too with the development of the collar, the presence or absence of the birth pore and the colour, which may differ from white to yellow or brown. On 15/VII 32 I found in a pond, Springdam near Hørsholm, *Limnaea stagnalis* heavily infected with echinostome Cercariae. Of 41 specimens 9 showed Cercariae. In the same snails two sorts of Rediae were observed in several specimens. The one was found in the liver, the other covered the lower part of the intestine nearest to the heart. The first-named was red, slender, had a small collar, small pharynx, small posterior locomotoric appendages, and a thin, rod-like intestine; they contained Cercariae in a number of 6—8, all fully developed; the other was extremely hyaline, it had a very large pharynx, a strongly developed collar; it had a very broad, thick gut, longer than in the first-named Redia. It was very clumsy, and contained either young, very slender Rediae or a number of germ-balls. The first-named form was present in enormous numbers, the last-named only in a number of 20—50. In the last-named case especially I have felt inclined to suppose that I have had to do with two different species. On the other hand, I cannot prove that they are not developmental stages of the same species.

I have preferred to refer all specimens found by me in *L. stagnalis* to one and the same form, *Cercaria echinata* Sieb. It must be remembered that many of the characters which we use to distinguish the Rediae from each other are subject to great variations; this is the case e. g. with the intestine. In Rediae producing Rediae it is often long and rod-like, in the Cercaria-producing Rediae broad and short. Mathias has made the same observation (1925, p. 77). In *Limnaea stagnalis* two main species, *C. coronata* Fil. and *C. echinata* Sieb., have been observed. *C. Hypodereae conoideae* Bloch may develop in *L. stagnalis* (Mathias 1925, p. 74, Dubois 1929, p. 53). In the first the ventral sucker is almost in the middle line of the body and the gut of the Redia long and tortuous, in *C. echinata* the ventral sucker is behind the middle line and the Redia has a very short rod-like gut. As I have never in *L. stagnalis* found Rediae with a long tortuous intestine, and the ventral sucker has always been behind the middle line, my species belong to *C. echinata*. Dubois (1929, p. 43) has described no less than eight different species from *L. stagnalis*. *Cercaria helvetica XX, XXI, XXII, XXIII, XXIV, XXXII, Metacercaria helvetica III* are all new species. I am afraid that all these species cannot be distinguished according to the descriptions and drawings, the last-named belonging only to the Rediae. — *E. echinata* is at all events nearly related to the Cercaria of *Echinostoma revolutum* Froelich so carefully described by Johnson (1920, p. 335). Echinostome-infected *Limnaea stagnalis* are found in very many localities; these are small ponds only of a few hundred square metres, moors and small lakes. From some of the localities 40 snails were gathered, in others it was not possible to get more than a single one. To calculate the percentage of infection in material of this kind is absurd in my opinion. Rediae were found in them all. I have seen very small ponds, where 10 out of 41 were infected, and others where the infection was very slight, only 1 out of 18. —

Whereas the *L. stagnalis* from the inundated moors near the borders of Furesø and Esromsø were pretty heavily infected, I have never found a single *L. stagnalis* from a depth of 3—4 m. in the Furesø infected. *L. stagnalis* is rare here; it is here replaced by *L. auricularia* and *L. ovata* var. *ampla* and in these localities *C. echinata* use these snails for their purpose; both are here heavily infected. 200 specimens have been opened at different times of the year. (10/V, 16/IX, 1/X, 31/X, 20/V and 18/XI 33).

At the time when the temperature of the water was only 7° C. many of the snails threw out numerous Cercariae. —

Cercaria Hypodereae conoideae (Bloch) Mathias. Host: *Limnaea ovata.*

Pl. XI, figs. 3—4—6.

The dimensions are:

Cercariae.

	Living	Preserved
Length of body	595	213—272
Breadth of body	190	92—141
Length of tail	480	243—326
Breadth of tail	75	29—46
Oral sucker	65	37—45
Ventral sucker	70	35—50

Rediae.

	Living	Preserved
Length of body	1510	720—1535
Breadth of body	320	129—277
Pharynx	110	97—129

Fully extended the body is long, attenuated behind, but also capable of great variation in form. There is a slight constriction behind the collar. This carried about 50 spines, all almost the same size and arranged round the disc in two alternate series; the number of lateral spines are 8 on each side. The oral sucker is a little smaller than the ventral one, and this is situated far behind the middle of the animal. The mouth opening carries on its anterior border six small taps into which most probably salivary glands debouch (they were, however, not observed). The cystogeneous cells fill all spaces between the organs and make it very difficult to get an impression of the fine structures, especially that of the excretory system. The cells are rather small near the sides of the animal, but much larger between the excretory canals. They are packed with cystogeneous material; all of them possess conspicuous nuclei. There is a remarkably long prepharynx, a well developed pharynx, and a long oesophagus which divides near the ventral sucker. The diverticula are difficult to see, but they reach the bladder. In this species the series of hyaline refractive bodies in the oesophagus are not so conspicuous as in *C. echinata;* but they are present. They are not mentioned by Mathias. —

As in *C. echinata* the bladder is divided into a posterior larger and an anterior smaller part, both parts are only rarely visible simultaneously, and if so, only for a very short time. Anteriorly the forepart gives off two sinuous tubules, which when they reach the ventral sucker bend posteriorly and then again anteriorly, and here change into two broad tubules containing enormous amounts of grains largest in the middle part and much smaller in the anterior and posterior parts. Arrived a little above the pharynx, they form the normal loop whereupon they pass back again. As far as I have been able to see, they then run directly down to the bladder where another loop is formed whereupon the tubules again bend forward and reach the collar, ending in three vibratile tags. In *C. echinostomi* the descending tubule, having reached the ventral sucker, divided into two branches, one running anteriorly, one posteriorly. It is the last part of the tubule nearest to the sides of the animal which carries the vibratile tags; the branches of the second order and the number of the vibratile tags have not been worked out. A posterior tube gives off two lateral branches in the first seventh of the tail.

The tail has no fin membrane. Beneath the fine cuticula lies a layer of circular muscle fibres, and below them again a layer of longitudinal ones. Scattered in the interior of the tail lie the parenchymatous cells with numerous round nuclei.

The Redia (Pl. XI, figs. 4 and 6) has a rather small pharynx and a short intestine, not more than twice the length of the pharynx. There is a collar and two posterior locomotoric appendages, very conspicuous in the young animals, but faintly developed in the old ones. The Redia is almost colourless, when old with a yellow tint. All my specimens were in the Cercaria-producing stages. Curiously enough, all the fullgrown ones almost always contained a few nearly fullgrown Cercariae and enormous amounts of very small globular germ-balls which filled the whole interior of the Redia, and among which the large Cercariae moved about slowly.

All dissected species of *L. ovata* contained, together with the Rediae, cakes of cysts, arranged round the intestine, often in a number of many hundreds. Often Cercariae were found which had thrown off the tail and were ready to encyst. Whether they come directly from the Rediae or from without I will not venture to decide. — I refer this species with some doubt to *Cercaria Hypodereae conoideae* Mathias. It is this very same species which has been very closely studied by Mathias (1925, p. 66). He has shown that the miracidia have a predilection for *L. ovata*, but may develop in *L. stagnalis*. On the other hand, *Planorbis* and *L. palustris* were not used as hosts. Mathias has furthermore found the Sporocyst in the lung of the *Limnaea*, and the Sporocyst contained Rediae. Nöller and Wagner (1923, p. 463) showed that encystation may also take place in tadpoles, and Mathias has shown that ducks fed with infected snails containing cysts, later on harboured *Hypoderaeum conoideum* in their intestine.

On all essential points my specimens agree with *Cercaria Hypoderaeae conoideae;* attention may especially be called to the following features: the oral sucker is a little smaller than the ventral one; the place of the ventral sucker is behind the middle line of the animal; further, the number of thorns upon the collar is the same. I refer also to Vevers (1923, p. 134).

The species has only been found a few times at Donse on 9/XI 31, at Amager on 27/IV 32, in the lake of Frederiksborg Castle on 10/V 32, and at Hørsholm on 1/VII 32. The number of infected snails was very small at Amager and in the lake of Frederiksborg Castle; it was only 1 out of 40. On the other hand, it was rather high at Donse (3 out of 10) and at Hørsholm (13 out of 30). — Cakes of cysts were found in all individuals, and most of the infected individuals produced many Cercariae before they were dissected. —

Cercaria affinis n. sp. Host: *L. auricularia.*

Pl. XI, figs. 1—2.

The dimensions are:

Cercariae.

	Living
Length of body	500
Breadth of body	205
Length of tail	475
Breadth of tail	55
Oral sucker	70
Ventral sucker	95

Rediae.

Length of body	490
Breadth of body	95
Pharynx	40

Fully extended the body is long, broader behind, strongly attenuated behind the collar. The number of spines is most probably 47; there are five lateral spines; all the spines are almost the same size. The oral sucker is much smaller than the ventral one, which lies in the last third of the body, long behind the middle line of the animal. The cystogeneous cells fill the whole body, they are packed with cystogeneous material; they possess conspicuous nuclei. There is a prepharynx and a well-developed pharynx; the long oesophagus gives off the diverticula just before the ventral sucker; they reach the bladder. A serial arrangement of large refractive bodies in the alimentary canal was not observed. No division into two parts of the bladder, an anterior muscular and a posterior more hyaline part, was observed. From the anterior corners of the bladder issue two sinuous tubules; when arrived at the ventral sucker they are broadened and contain a large amount of granules. Arrived at the collar they attenuate and form the loop normal to all observed echinostome Cercariae, whereupon they bend back; when they reach the ventral sucker as far as I have been able to see they divide, sending out one branch anteriorly to the oral sucker and another which reaches the bladder. The last named makes a peculiar loop outwards. These two branches carry the flame cells, which are remarkably conspicuous. Of these I have found 19 on each side, but I do not venture to draw the branches of the second order carrying these flame cells. The posterior branch gives off two lateral canals in the first sixth part of the tail. The tail has the normal equipment of a layer of circular and longitudinal muscles and parenchymateous cells in the interior. There is no finfold. —

The Redia (Pl. XI, fig. 5) is long, rod-like; there is a well-developed pharynx, a collar which is not very conspicuous, and faintly developed posterior locomotoric appendages. The intestine is very long, almost reaching the posterior end of the body.

This form has only been found in one of 10 specimens of *Limnaea auricularia* in the Susaa near its outflow into Tjustrup Lake on 2/VI 31. The Redia contained fully ripe Cercariae to the number of 10—12. Cysts were not observed. It is most probably the same species which I have found in 9 of 20 specimens in Esrom Lake.

I suppose it must be described as a new species. It has the long intestine of the Redia common with *C. coronata* Fil. and the large ventral sucker behind the middle line common with *C. echinata* Sieb.; as far as I know no European echinostome Cercaria has been described with a long Redia intestine and a large ventral sucker behind the middle line.

It will now be seen that so far the following 9 species have been found in Denmark:

Cercaria echinatoides Fil.	*Paludina vivipara*	Hellebæk.
C. echinostomi Dubois.	*Limnaea palustris*	Bromme.
C. abyssicola n. sp.	*Valvata piscinalis*	Tjustrup Lake.
C. Echinoparyphii recurvati Math.	*Planorbis umbilicatus*	
C. spinifera La Val.	*Planorbis corneus*	
C. echinata Sieb.	*Limnaea stagnalis*	
C. Hypodereae conoideae Math.	*Limnaea ovata*	
C. affinis n. sp.	*Limnaea auricularia*	Tjustrup Lake.
C.	*Planorbis albus*	

On 1/VIII 32 I found, in a single specimen of *Planorbis albus* taken in a pond in Frederiksborg Castle Park, an enormous Redia 2 mm. long. It filled a great part of the little snail which contained only this one Redia. It had a peculiar, small pharynx and feebly developed corona. The intestine was almost half as long as the whole body; the posterior locomotoric appendages were feebly developed. The colour was yellow. It is shown in Pl. X, fig. 15. It only occurred in one out of 80 specimens, and has not been found later on. The dimensions are:

Length of body	2280
Breadth of body	200
Pharynx	60

Biological remarks.

1. The Cercariae of the Echinostomes are rather vigorous swimmers. By means of their powerful tail they move quickly through the water; nevertheless they live near the bottom and do not belong to the midmost water layers; in the last part of their life as freely moving organisms they creep on the bottom and are then subject to great variation of the body.

2. Several species are phototatic, but not in any considerable degree.

3. Of the parthenitae the Sporocysts seem to play a very inconspicuous role; propagation, as far as I have seen, takes place the whole year round, mainly by means of Redia-production; many Redia generations may succeed each other. In this way the snails may contain many thousands of Rediae, and the liver presumably contain echinostome Rediae only. (*Hypoderaeum conoideum,* 8500 in *Limnaea stagnalis* Dufour. 1929, p. 129). Nevertheless, even these highly infected snails do not produce such enormous amounts of Cercariae as is the case with Xiphidio- and Furcocercariae; I have not seen more than several hundred a day. This is presumably due to the fact that the number of Cercariae which a Redia produces in a single batch is but small, rarely more than 10—20. The Redia-producing time of the year is much longer than the Cercaria-producing period which is mainly restricted to the summer months; in that time Rediae with Rediae as well as Cercariae are often found; owing to the strong muscular collar and well-developed posterior locomotoric appendages the Rediae of the Echinostomes possess a great power of locomotion.

4. The very vigorous pharynx is used as a hold-fast organ with which the Redia is fastened to the tissues of the snail and also as an organ by means of which morsels of snail tissues or germ-balls or other Rediae are swallowed (Pl. XXXVIII fig. 14). — On the whole, the Redia of the Echinostomes belong to the most developed and most highly differentiated Rediae hitherto known. —

5. In contradistinction from the Gymnocephala the Echinostomes are almost always found in *Pulmonata* not in *Prosobranchiata.* Though I have dissected about 1800 specimens of *Bithynia tentaculata* I have never found a single specimen of an Echinostome in Bithynia. Most of them are found in *Limnaea* species, not so many in *Planorbis.*

6. With regard to the encystation of the Echinostomes, different views have been advanced. After a brief survey of the literature, I shall give my own observations in the following.

The Encystation of Echinostomes.

As is well known, the echinostome Cercariae hitherto known do not encyst on plants or dead material; after their short life as free-swimming organisms, they make their way into other organisms. According to the literature these seem mainly to be snails; this may be due to the fact that most of the observations are derived from studies in aquaria, which contain snails, Echinostome cysts are, however, also common in *Cyclas* and *Anodonta;* Hollande (1920, p. 543) found numerous cysts on the stomach and the intestine of *Dytiscus marginalis;* however, it is doubtful whether they were cysts from echinostome Cercariae. I have often, when dissecting larvae of water insects, found cysts of *Echinostomes,* especially in the muscle system; nevertheless, their number has almost always been surpassed by cysts belonging to *Xiphidiocercariae.* Nöller and Wagner (1923, p. 463) found them in the larvae of *Rana esculenta;* they have furthermore fed ducks with these larvae and shown that here they developed into *Hypoderaeum conoideum.* Filippi (1854, p. 345) already observed that cysts which he referred to *Cercaria echinatoides* were found in the auricle of a *Paludina.* He maintains that it is almost impossible to find a single *Paludina* in the Lac Varese which had not the auricle so packed with echinostome cysts that it was almost impossible to understand how the organ could function. Of fifty species every single one was infected. Usually neither Cercariae nor Rediae were present. Hence Filippi came to the conclusion that the parthenitae had disappeared and that these cysts testified to an earlier occurrence of Rediae and Cercariae.

Lebour (1912, p. 442) states that in exceptional cases the echinostome Cercariae may encyst in its first host. —

Cort (1915a, p. 37) found, with regard to *Planorbis trivolvis,* that it was able to serve both as intermediate and as secondary intermediate host for *Cercaria trivolvis;* he found the Cercariae in the liver and encysted Cercariae in the body cavities of the snail. He found six of thirty-six specimens of *Campeloma subsolidum* with cysts of *Cercaria rubra* (1915a, p. 40) in the tissues above the gills. The same was the case with *Cercaria reflexae* (1915a, p. 42), and Cort could here show that the Cercariae were continually making their way out of the snails, whereupon they encysted in others. During the first days after the snails came into the laboratory only a few contained the encysted Cercariae; later all were infected.

Faust (1917a, p. 78) seems to be of opinion that *Cercaria trisoleneata* encysts on a substratum, not in another organism, "after it has escaped from the liver tissues of the host" (p. 80). On the other hand, *C. biflexa* is said to encyst in the primary host immediately after breaking through the birth-pore of the Redia. With regard to *Echinostoma revolutum* Johnson (1920, p. 361) states that the secondary intermediate host is the same as the intermediate host, he maintains that the cysts "grow". He has observed that the Cercariae often escape from the snail only to reenter the same species to form the cyst; furthermore that the Cercariae need not enter the same snail from which they came. Johnson has found more than four hundred cysts in one snail, and contends that it is highly improbable that so many Cercariae should find their way into the same snail. Further, he has found cysts, not only in the snail, but also in the Redia itself. He has found fifty-eight Rediae with cysts inside, two of them harbouring four cysts. He regards it as certain that it is the Cercariae developed in the Rediae which also encyst in them. —

Mathias (1925, p. 81) has shown experimentally that the Cercariae of *Hypoderaeum conoideum* encysts in different snails, thus in *L. ovata, palustris, stagnalis,* *Planorbis corneus* and *Planorbis* sp. In *Planorbis* they were not found in the liver, only in the walls of the lung, or in the mantle. In *Limnaea* they occurred almost everywhere, also in the liver. In contradistinction from Johnson he supposes that all the cysts, even if present in a number of several hundred, derive from Cercariae which have entered the snail from without and that normally they have a short period as free-swimming organisms. He arrives at this result from his own studies relating to the development of *Strigea tarda*.

Mathias (1927, p. 295) shows that *Echinoparyphium recurvatum* encysts in *Planorbis umbilicatus, Limnaea ovata, L. palustris, Cyclas* sp., and that the number of cysts in *Pl. corneus* may be enormous, "plusieurs milliers", "le tortillon veritablement farci de ces cystes". He has also, though only once, found three echinostome cysts in a Redia. He still maintains that in all cases they enter the snail from without. I refer to p. 55—60.

Sewell (1922, p. 128) found echinostome cysts in sixty out of 67 specimens of *Vivipara bengalensis* deriving from different localities. On examining *Vivipara bengalensis* var. *annandaeli* from a tank at *Baliaghatta*, Calcutta, he found that in 10 individuals no infection was present. On the other hand, when he examined eleven specimens from the experimental tanks, infection was present in ten cases. It seems clear therefore that, in this case, infection had occurred during the sojourn of the snails in the experimental tanks. —

My own observations have given the following results. Echinostome cysts are very often found in dissected snails. A closer examination will reveal these cysts in very many cases. Often their number is small but they may be present by thousands, as stated by Mathias. They are not found in the same organ in the different snails. In *Planorbis* and *Paludina* they almost always occur in the auricle, in the *Limnaea* scattered over almost all the organs and mainly in the liver but not in the auricle. Very often molluscs are found which only contain echinostome cysts but neither Rediae nor Cercariae. Furthermore, the snail may very often be infected simultaneously by other Cercariae, especially *Xiphidiocercariae* and *Furcocercariae*. A closer examination often shows that the cysts are not of the same size. Among many hundred cysts of one size several much larger ones are often found; these are yellow and unquestionably do not belong to the same species as the others. From these observations it would seem allowable to suppose with Mathias that the cysts originate from Cercariae which have entered the molluscs from without and have not been developed in the host itself. —

In September 1930 I took several *Paludina vivipara* into the laboratory from a pond in Hellebæk; they were used for other purposes and were not studied in regard to an infection with Trematoda. They wintered, and during the days 2/III to 30/III nine were dissected. A feature common to them all was that the auricle were enormously distended and that they contained hundreds of echinostome cysts. When taken out of the cyst, it was seen that the larvae had four lateral spines which were larger than the dorsal ones. It was highly probable therefore that the cysts belonged to *C. echinatoides* Fil. whose host is *Paludina vivipara* and which is characterised precisely by the larger size of the lateral spines. In none of the specimens could be found Cercariae. I refer to p. 46.

On 3/IV, when the pond was ice-free, 10 *Paludina* were gathered; the auricle contained some cysts but by no means as many as the aquaria specimens. On 26/V 37 *Paludina* were gathered from the same locality. The auricle only rarely contained more than 10—15 cysts; 2 possessed 43 and 72 each. Only one individual had the auricle quite packed with several thousands. On 1/VII, 15 Paludina were gathered again, 9 had only 1—5, and only 4 had from 13 to 22. On 18/XI of 13 specimens, only 2 to 3 showed cysts. On 2/II of 10 specimens, again, only 2 to 3 had cysts.

The curious thing was that in none of all these specimens from the above-named dates could I ever find either Rediae or Cercariae. Not until 2/II did a single specimen occur which had several Rediae containing 4—6 Cercariae, not quite ripe. This same *Paludina* contained an enormous amount of cysts; whereas in all the other specimens they were restricted to the auricle, here the cysts were also found in the liver.

It is not easy to interpret these facts. As the enormous amount of cysts in the auricle have mainly been found in the snails which have lived in aquaria, or in February after hibernation in the pond, whereas the number of cysts found in the auricle in Nature during the summer is but small, I presume that, under unfavourable conditions, at low temperatures, encystment may take place in the snail in which the Cercariae are born; at higher temperatures, during the summer, they most probably encyst not only in the *Paludina* but in others hosts as well, and the Cercariae have probably a short free-living period. My observations seem to corroborate Filippi's view that the Cercariae may completely disappear in a given locality, while the cysts remain as evidence of their previous occurrence there. —

With regard to *Planorbis corneus* the case is quite different. Here Rediae, Cercariae, and cysts are very often found in the same snail; snails with Rediae and Cercariae alone, and snails which only contain cysts also occur. —

Thus investigations in the Torkeris Pond gave the following results:

Torkeris Pond.	6/V	50 spec. with cysts.	50 spec. with Rediae.	9 spec.
— —	29/IX	30 — — —	30 — — —	3 —
— —	24/IV	45 — — —	45 — — —	13 —
— —	11/VIII	25 — — —	25 — — —	3 —

In other words, this means that all 150 specimens have had cysts and 28 Rediae.

In a few localities snails with echinostome Rediae and Cercariae but without cysts were found, but in 9 localities where investigations were carried on in January, April, May, July and September, and where a total of 98 specimens were opened, cysts were found in every specimen. They were almost always found gathered in a lump on the outer wall of the lung and near the heart. This might be as large as a large pea, and contain several thousand cysts. In all these 98 specimens not a single Redia or Cercaria was ever observed; on the other hand, they were very often infected either with Furcocercariae or Xiphidiocercariae. It is very curious that we so often find *Planorbis* with hundreds of echinostome cysts gathered in a lump on the same spot, whereas the liver is entirely free from echinostome Rediae and Cercariae. We are here compelled to suppose one of two things. Either the Redia generations in the *Planorbis* have died out and the Cercariae encysted in the same host, or the snail has never been attacked by echinostome Miracidia but the attack began with Cercariae which entered the snail from without to encyst in it. — I regard the latter supposition as the most probable. — And all the more so, since very often e. g. Strødam pond, I found the *Planorbis* lying side by side with *Limnaea stagnalis* which were highly infected with Echinostomata and giving off Cercariae in plenty. As the number of echinostome cysts found in *Limnaea* was always small, I suppose that the Cercariae, having left the *Limnaea*, entered the *Planorbis*, especially because the cysts found in *Planorbis* are of a different size. In other words this means, in localities where both snails are present, a regular change of host takes place, the Miracidiae entering the *Limnaea* whenever the Cercariae enter the *Planorbis*. Owing to the very heavy infection of the *Limnaea* and the enormous amount of Cercariae produced by the snail during its life-time on the one hand, and the scarcity of cysts on the other hand, there can be no doubt that the Cercariae normally and most probably at all events during the summer months leave the snails and encyst in other organisms.

On the other hand, some observations show that encystation really may take place in the very same snail in which the Cercariae are born, and precisely in *Limnaea stagnalis*. This seems especially to be the case during hibernation or when the snail dies. On 26/I 30 *Limnaea stagnalis* were taken from a pond in the Strødam reservation. Of these 30 snails 12 were infected with echinostome Rediae; some of these were in Redia-production, most of them in Cercaria-production, but the Cercariae were not quite ripe. There were no Cercariae outside the Rediae. Two specimens were left alive. Temperature in the pond + 2° C., in the aquaria 20° C. On 15/II one of the two died; in the last few days it had thrown out many Cercariae. On 16/II the other snail was dying; it died at 2 o'clock. It contained enormous amounts of Rediae in which fully developed Cercariae were still living. Outside the Rediae most of the Cercariae were dead, many were dying, but very many were in the different stages of encystation. During observation many cysts were formed and there was an extraordinarily good opportunity to follow the process.

Many of these Cercariae are remarkably broad and flat, almost isodiametric; they lie on the dorsal side with the tail bent over the ventral side; many have lost the tail (Pl. X figs. 7—8). When this is the case, a slimy secretion appears round the posterior part of the body (fig. 8); the slime is immediately seen to be of two sorts, an outer hyaline and an inner thicker and darker kind. Then the animals begin to roll themselves into the slime (figs. 9—10) whereupon the rotation takes place during increasing slime secretion. In fig. 14 the finished cyst is seen. —

Figs. 11—13 show animals which are dying or have died during the process.

After this there can be no doubt that Cercariae ready to escape when the snail is dying, encyst in the snail itself.

Pl. umbilicatus were taken on 11/II 32 on the moors near Hillerød (10 specimens); one of them was enormously infected with echinostome brood. On the liver there were about a hundred very old Rediae; they were almost immobile, among them were found a few young more mobile Rediae. Only very few Cercariae were found outside the Rediae, and in them only a few ripe ones were observed. The interesting point was that the whole liver consisted almost entirely of hundreds of cysts, fully developed. This shows that at low temperatures the Cercariae which are ripe do not make their way into the water, but really encyst in the snail in which they are born. —

From my own observations I suppose therefore that MATHIAS is right, when he thinks that the echinostome Cercariae normally leave the host and encyst in a second one; this may often be a snail, but it may also be another organism. On the other hand, I suppose that encystation in the primary host during hibernation is a common thing, and may also take place during the summer under abnormal conditions, when the snail is dying. This may be the case too when snails in aquaria are badly fed. The accumulation of cysts in snails kept for months in aquaria is a phenomenen caused by the fact that the aquaria may not contain organisms in which the Cercariae can encyst in other than the primary host. —

As is well known, most of the Echinostomes mature in birds, especially water birds. Now the singular thing is that in our fauna, and I suppose in the whole of the north European fauna, as far as I know, there are no water birds which directly eat the large *Limnaea stagnalis* and *Planorbis corneus*. I have often in early spring seen the common crow sitting at the borders of our moors, and I know their eating places well. By the ponds at Donse, some few kilometres distant from Hillerød, I have several times observed the peculiar fact that they take the large *Anodonta* in their claws, rise some metres in the air, and then drop them on the stones. An examination of these feeding places brings also to light numerous broken shells of the large *Limnaea* and *Planorbis;* also blackbirds and other thrushes visit these localities. The rich infection of waterbirds with Echinostomata must, in my opinion, take place in another way. —

In early spring many dying or dead snails are to be found which swell during the process of decomposition and protrude from the shells. At the borders of our lakes I have at that season found jelly-balls partly in partly outside the shells of the large *Limnaea auricularia* from Furesø. The snails are stirred up by the breaking ice, they die and at slightly higher temperatures their bodies decompose. The balls form a band half a metre broad and many metres long along the wind-eroded shore. These observations, now more than twenty years old, were made at a time of my life when I had no acquaintance with Trematoda. In my aquaria the decomposing snails also swell and protrude from the shells, and the cysts are found in the decomposing material. Experiments have shown that in my vessels the cysts do not survive the process of decomposition. In Nature, however, it is probably otherwise. The balls decompose in large quantities of fresh, well aerated water and, in early spring, at low temperatures during incessant motion owing to the washing of the waves. I presume that the living, encysted Trematoda drop out of the snails during their decomposition and are deposited by thousands along the shores in the soft mud which, especially in spring and autumn, shows so many marks of the feet and beaks of wading and swimming birds. Our waders and swimming birds, when looking for smaller snails, worms, and algae, have ample opportunities of getting the cysts from the larger ones, on which, as far as I know, they rarely feed.

Chapter V

Xiphidiocercaria.

General Remarks.

The main characters by which the Xiphidiocercariae may be distinguished from each other are the size of the oral sucker in relation to the ventral one; the position of the ventral sucker; the development of the alimentary canal; the presence or absence of a fin membrane along the borders of the tail; the number and position of penetration glands. —

Some characters may be found in the structure of the stylet, but in my opinion the value of these characters has been somewhat exaggerated. See also Faust (1917 a, p. 32). As I have seen it used directly as a penetration organ, I regard it as an organ by which the Cercaria forces its way into the secondary host. The excretory system seems always to be of the same main type: an excretory bladder, commonly bilobe, rarely round with two excretory tubes which, near the ventral sucker, divide into an anterior and a posterior tube. Posteriorly the bladder gives off a tube running through the whole length of the tail. A character of systematic value may in some cases be found in the number of flame cells. In many cases the relation between the transversal and the longitudinal diameter of the Sporocysts as well as the number of Cercariae in the Sporocysts furnish good characters. The virgate group is identifiable at a glance by the virgate organ. Cysts may almost always be recognised by means of the stylet which has been thrown off and is lying between the cyst membrane and the animal.

It may as a rule be said that the species from Prosobranchiata are not the same as those from lung snails; and those from *Planorbis* are not identical with those from *Limnaea*. —

If Pl. XVI, fig. 1 and fig. 2 of *C. nodulosa* are compared with each other, it will be seen that the ventral sucker in the contracted individual (fig. 1) lies in the middle of the body, while in the extended individual (fig. 2) it is situated in its posterior part. This is due to a fact which I have often observed and especially in the Xiphidiocercariae. It is mainly that part of the body which lies before the ventral sucker which is subject to the great variations in length; the part behind is more stable. Since the position of the ventral sucker is used as a systematic character, this fact should be noted; in this paper the position of the ventral sucker is always given when the animal is contracted to what may be regarded as the normal size in the live state.

With regard to the excretory tube in the tail CORT (1919 a, p. 279) says that he has never seen any trace of it in the tail. SEWELL (1922, p. 225) and FAUST (1918 a, p. 103) arrive at the opposite result; the explanation may be that what the two last-named authors have recorded as an excretory tube has not been interpreted as such by CORT. For my own part I likewise suppose that the string running through the central part of the tail is an excretory tube, but I confess that in some cases the interpretation is probably doubtful. In all examined species the tail has a transversal muscle layer and longitudinal muscles. They seem to be of the same structure in all species; as a rule they are not shown in the figures.

The tail is commonly inserted in a so-called caudal pocket (FAUST) which in American and Indian forms is said to possess small lappets provided with spines in different numbers. As far as I know, these organs have not been observed in European species. They may perhaps have been overlooked.

The number of penetration glands is often difficult to ascertain. They frequently show variations in the type of granulation of the protoplasm. —

In almost all observed species the body contains great amounts of cystogeneous cells. Commonly they are placed laterally as great bands or they are scattered throughout the body. Their content is not, as in the Echinostomes and the Gymnocephala, of a rod-like structure, it is more hyaline. Scattered throughout the body there also often occur a great number of oil globules. —

Cercariae ornatae.

Cercariae ornatae are characterized by a fin-like projection extending over a greater or smaller part of the tail (LÜHE). Originally they comprised two forms, *C. ornata* La Val. and *C. prima* Ssin. To them CORT (1915 a, p. 57) added *C. hemilophura*. SEWELL (1922, p. 217) added two Indian forms *C. Indicae XXIV* and *XXVIII*, and created a special subgroup for all the species apart from *C. ornata*: the "prima" group, mainly characterised by the ventral sucker being smaller than the oral sucker and lying behind the middle of the body length; the tail is shorter than the body, and a dorsoventral finfold extends only in the distal portion; the intestinal coeca reach a point between the posterior margin of the acetabulum and the posterior end of the body. Salivary glands are present and consist of 4 or 5 cells on each side. The excretory bladder is oval; the excretory canals are dilated in their posterior part; the excretory formula seems to be $2 \times 6 \times 1 = 12$. Development in oval sack-shaped Sporocysts. —

DUBOIS (1929, p. 35) says that SEWELL "complète la définition" for Lühe's *ornata* group by the above-named points. This, as far as I can see, is not correct. Sewell (1922, p. 217) says "I, therefore, propose creating a subgroup of the Cercariae ornatae to accomodate *Cercaria prima* Ssin. and *Cercariae Indicae XXIV* and *XXVIII* under the name of the "Prima" group", and it is this subgroup and not the group *ornatae* which he characterises by the above-named points. He expressly points out the fact that *C. ornata* shows considerable differences. —

As far as I know, no one has found *C. ornata* after it was described by la Valette (1855, p. 18). It is mainly characterised by the finfold which extends over the whole length of the tail, and by the size of the ventral sucker which is said to be much larger than the oral one, the former being 0.07 in diameter, the latter 0.01—0.03 i. e. more than twice as large as the oral one. If this is right, *C. ornata* would as far as I know, be unique in this respect among all Xiphidiocercaria. It may be added that in la Valette's own figure, fig. O, Pl. I the ventral sucker is only very slightly larger than the oral one.

Cercaria laticauda n. sp. Host: *Limnaea stagnalis.*

Pl. XII, figs. 1—2.

The dimensions are:

Cercariae.

	Living
Length of body	500
Breadth of body	170
Length of tail	190
Breadth of tail	85
Diameter of oral sucker	85
Diameter of ventral sucker	75

Sporocysts.

Length	275
Breadth	90

The stylet has rather conspicuous lateral projections. After the large oral sucker follows a short prepharynx and an oblong pharynx; the oesophagus is rather short; the intestinal diverticula branch off immediately before the ventral sucker and embrace it; they do not reach below the posterior border of the ventral sucker. The latter lies almost in the middle of the body and is a little smaller than the oral one. There are two groups of penetration glands with many large pear-shaped cells and ducts which run to the base of the stylet. The excretory bladder is extremely large, with the two horns almost reaching the ventral sucker. The two excretory tubes divide near the middle of the ventral sucker, sending one branch anteriorly and another posteriorly to the base of the tail. Posteriorly the excretory bladder sends off a branch through the whole length of the tail. The structure of the tail is rather peculiar. I have never seen it extended to more than half the length of the body; it is remarkably broad, when fully stretched out, acute; but when contracted very broad posteriorly; the finfold surrounds the tail in its whole length. There is a conspicuous transversal musculature and a very strong longitudinal muscle band running through the central part of the tail. Hidden in it runs the presumed excretory tube. — The whole animal is dark, mottled, with many dark spots. The interior is filled with cystogeneous cells. The Sporocysts are broad, irregular, oblong bodies containing many Cercariae. —

The form was found in a single specimen of *L. stagnalis* (13/II 32) gathered in Strødam, the pond from which several hundreds have been examined. There was a double infection with this species and Furcocercaria. The latter were found in the liver; the Sporocysts of the Xiphidiocercaria mainly on the intestine and near the heart. I have been inclined to refer this form to *C. ornata* La Val. but his species was found in *Planorbis corneus* and mine in *Limnaea stagnalis*. Partly owing to this fact, and partly because the ventral sucker is smaller than the oral one, I am provisionally compelled to regard this form as a new one. —

Cercaria prima Ssin. Host: *Planorbis albus.*

Pl. XII, figs. 3—4.

The dimensions are:

Cercariae.

	Living
Length of body	290
Breadth of body	140
Length of tail	120
Breadth of tail	55
Diameter of oral sucker	55
Diameter of ventral sucker	50

Sporocysts.

Length	65
Breadth	50

The stylet is rather short with conspicuous lateral projections. The oral sucker is a little larger than the ventral one; the latter lies behind the middle line of the animal. The prepharynx is long; then follows a rather small pharynx. The oesophagus divides into the two intestinal coeca a little before the ventral sucker; they scarcely reach halfway along the sides of it. There are four penetration glands on each side; and they lie before the ventral sucker. The ducts pass forward to the base of the stylet. The excretory bladder is large, bilobed, with the unpaired part remarkably broad, the paired parts almost reach the posterior border of the ventral sucker. The excretory tubes pass forwards and divide a little above the ventral sucker, sending off one branch anteriorly and one posteriorly. The tube in the tail has only been seen indistinctly. The tail is broad and short; not more than three-fourths of the length of the body. The finfold is very peculiar. It reaches the base of the tail but is extremely small there; at the rounded end of the tail it is very broad and folded in a peculiar manner, the folds not always reaching through the whole membrane.

The Cercariae develop in small almost globular Sporocysts not containing more than one or two Cercariae.

C. prima was found on 2/VIII 1932 in *Planorbis albus* in one of fifty specimens from a little pond in the park of Frederiksborg Castle. The specimens have not been seen swimming in the water. They came out when the snail was dissected, and were perhaps not quite ripe. This may be the reason why I have not seen the long sensory hairs mentioned by Ssinitzin; why the finfold of the tail has such a peculiar appearance; and the intestinal diverticula are so short. —

Cercariae armatae.

C. armatae were described by Lühe (1909, p. 191) as Xiphidiocercariae without a finfold, a tail almost of body-length, a ventral sucker a little behind the middle of the body and either of the same size or only a little smaller than the oral one, with an excretory bladder of **Y**-form and a size of body surpassing 0.25 mm. Later authors divided the group into two: the *Polyadena* group of Cort (1915 a, p. 56) and the *Dawson* group (Sewell 1922, p. 234). The *Dawson* group is not with certainty found out side India; I do not think it correct (Dubois 1929, p. 58) to refer *C. limnaeae ovatae* to it. I will only add that I have never seen the caudal pockets armed with needle-like spines which are mentioned by Sewell (1922, p. 225) and figured by him in his Indian forms; as far as I know they are not observed by European authors. I regard it as hopeless to refer the European forms to special groups.

Cercaria limnaeae ovatae v. Linst. Host: *L. ovata.*

Pl. XII, figs. 5—6. Pl. XIII, fig. 1.

The body is covered with a fine parallel striation but there are no spines. The dimensions are:

Cercariae.

	Living
Length of body	380
Breadth of body	175
Length of tail	125
Breadth of tail	55
Diameter of oral sucker	75
Diameter of ventral sucker	60

Sporocysts.

Length	420
Breadth	65

The stylet has lateral wing-like projections. The ventral sucker is a little smaller than the oral one; it lies behind the middle of the body. After a short prepharynx follows a small pharynx and a long oesophagus which divides before the ventral sucker. The intestinal coeca reach the middle of the excretory bladder. There are at all events five penetration glands situated before the ventral sucker; the ducts debouch at the base of the stylet. The excretory bladder is bicornous with the two horns almost reaching the ventral sucker. The two excretory canals divide near the middle of the ventral sucker into an ascending and a descending branch. Posteriorly from the bladder a branch runs through the whole length of the tail. The tail itself when contracted is only one-third of the length of the body; fully extended it is as long as the body.

The Cercariae develop in Sporocysts (Pl. XII, fig. 6) which are about 6—7 times longer than broad. The host is *Limnaea ovata*. The species is very common, it occurs in many localities; it could best be studied in the ponds of Strødam.

On 7/XII 32 material of *Planorbis corneus, Limnaea ovata* and *Limnaea stagnalis* was taken into the laboratory from Strødam. Xiphidiocercariae were thrown out of all the three species. This means, in other words, that Cercariae are produced at temperatures around zero and either retained in the snail during the winter, then perhaps encysting in it, or thrown off when the temperature rises a little.

In the vessels with the three above-named snails which all threw out clouds of Cercariae, *Corethra plumicornis* larvae were introduced. Those from *Pl. corneus* soon came to the *Corethra larvae;* they crept round on them, sooner or later they were found with the oral sucker fastened to the larva, the body strongly contracted and the tail moving. The stylet was held in a slanting position; it looked as if the Cercaria was going to form a furrow; before it was found a depression, but then the whole process ceased, and I never found Cercariae in the larvae.

The Cercariae from *L. stagnalis* showed no affinity at all for the *Corethra* larvae; on the other hand those from *L. ovata* darted at them immediately. In an incredibly short time they had pierced the skin. Pl. XIII, fig. 1 shows the Cercariae in different stages of piercing. The tail is thrown off, and the Cercariae are found creeping round in the *Corethra* larvae. When these larvae are put into the vessel with *C. ovata* at 11 o'clock, all larvae are dead before evening. Their body is packed with cysts often numbering several hundreds. —

The next day the bottom of the vessel containing *Limnaea ovata* was covered with a white layer of dead Cercariae. To my astonishment it could be shown that there were two forms in the material, the one twice as large as the other. The vessel contained three *L. ovata* all from the same locality. These three *L. ovata* were now isolated and *Corethra* larvae put into each of the vessels. One of them showed no Cercariae; the second only the large form, which was *C. limnaeae ovatae,* the third a small form, which was a microcotyleous Cercaria. In the course of 5 hours all the *Corethra* larvae in the vessel with *C. limnaeae ovatae* were dead, whereas those with the Microcotyles were all alive and continued alive long after all Cercariae had been thrown off and were dead. The larvae from the vessel with *C. limnaeae ovatae* contained hundreds of cysts; those from the vessel with the Microcotyle, not a single one. This little experiment shows how cautious we should be in our experiments and our conjectures.

Cercaria Haplometrae cylindraceae Zed. Host: *Limnaea stagnalis.*

Pl. XIII, figs. 6—10.

The dimensions are:

Cercariae.

	Living
Length of body	205
Breadth of body	80
Length of tail	65
Breadth of tail	25
Diameter of oral sucker	45
Diameter of ventral sucker	45

Sporocysts.

Length	80
Breadth	30

The ventral sucker is only a little smaller than the oral one; it lies a little behind the middle of the body. The stylet is long, thin, acute and has no thorn-like lateral extensions. The prepharynx is very short, the pharynx well-developed, the oesophagus long, the intestinal diverticula branch off immediately before the ventral sucker; they seem very short, and embrace only the anterior border of it. It is possible that I have not seen the last part. There are 4 or 5 penetration glands on each side of the sucker; the ducts pass forward to the base of the stylet. The body is filled with cystogeneous cells, which make it very opaque. The bladder is bicornous; the two horns commonly reach only halfway to the ventral sucker. Of the two excretory canals only very little could be seen; posteriorly it gives off a tube through the tail. The tail varies greatly in form; when the animal is swimming, the tail is as long as the body; when creeping only one-third of it.

The species is hatched in Sporocysts, Pl. XIII, fig. 10, 3—4 times longer than broad, covered with a yellow paletot.

The species is common in many localities; the main host is *Limnaea stagnalis.* In a little pond near Gadevang (Clausen's brick factory) the snails were much infected with them. On 19/V 1931 in almost all the snails the liver consisted almost entirely of a yellowish red porridge of Sporocysts; during the winter, at low temperatures, the whole energy of the parasite has been given to the production of Sporocysts by division. The Sporocysts contained enormous amounts of unripe Cercariae; simultaneously the snails contained a similar quantity of Tetracotyle, which as soon as the shell was broken, poured out in a broad milky stream. On 19/V 31, when 12 snails were taken, every one of them contained Xiphidiocercaria and Tetracotyle, but now the Cercaria production was going on. The shells were extremely dilapidated; the cuticula broken off, the limelayers very thin, and everywhere holes could be found through which the mantle could be seen. Placed in vessels, the snails threw out enormous quantities of Cercariae. The snails were furthermore literally covered with a cap of *Chaetogaster limnaei* which most probably preyed upon the Cercariae. LÜHE maintains (1909, p. 106) that the Cercariae encyst in *Ilybius fuliginosus*. When *Corethra* larvae are placed in the vessels the Cercariae dart at them, and immediately make their way through the skin; several times I found Cercariae with tails, creeping in the larvae. In the course of a few hours the larvae contained several hundred cysts and were all dead (Pl. XIII, fig. 8). In July all the large *Limnaea* with strongly corroded shells were dead.

The same species was found in *L. palustris* in other localities, especially at Bromme Lake near Sorø (20/X 31). Here many cysts were found together with Cercariae; the cysts had the stylet thrown off, often lying between the cyst wall and the animal (Pl. XIII, fig. 9).

Cercaria gracilis n. sp. Host: *Planorbis corneus*.

Pl. XIII, figs. 2—5.

The cuticula is striated with fine parallel oblique lines.

The dimensions are:

Cercariae.

	Living
Length of body	280
Breadth of body	105
Length of tail	165
Breadth of tail	25
Diameter of oral sucker	55
Diameter of ventral sucker	40

Sporocysts.

Length	710
Breadth	85

The ventral sucker is a little smaller than the oral one; the stylet has two sharp lateral points; the ventral sucker lies almost in the middle line of the animal. There are four penetration glands on each side; the two anterior pair have a conspicuous granular content, whereas the content of the two posterior ones is more homogeneous. The ducts pass forward to the base of the stylet. The prepharynx and the oesophagus are almost of the same length; the intestinal coeca branch off before the ventral sucker and almost reach the posterior border of the animal. The excretory bladder is bicornous, but the unpaired part is commonly very long. The two horns almost reach the ventral sucker. It is extremely variable in form; one moment only the posterior unpaired part is visible, slowly the horns are filled. For a moment the whole bladder is visible, then the posterior part disappears and only the horns are seen. They give off two excretory tubes which divide into an anterior and a posterior branch. From the posterior part of the bladder issues a branch running through the tail in its whole length. Contracted, the latter may be only one-fourth of the length of the body, but extended as long as the whole body. This is packed with cystogeneous cells, which give the body its greyish yellow colour and make it very opaque. The Sporocysts (Pl. XIII, fig. 4) are oblong bodies, often 8 to 10 times longer than broad; their colour is red or yellow; they have a conspicuous paletot and contain enormous amounts of germ-bodies or Cercariae. Once I saw a Cercaria come out; there seemed to be an anterior opening which was only visible when the Cercaria was to be born. —

The host is *Planorbis corneus* which, in my area of exploration, is heavily infected with this form. In the neighbourhood of Hillerød 6 localities are known where the snails are parasitised and commonly to such a degree that 50, 70, or even 100 per cent. are attacked. Where the *Planorbis corneus* is common, incredible amounts of Cercariae may be thrown off. It is especially this very species which may cause the white spots of milky water in our ditches among the leaves of *Potamogeton natans* and other water-plants. Now and then the snails are also infected with Tetracotyle; in a few cases I have seen Tetracotyle in the Sporocysts. In my experience this is a rare case; commonly Tetracotyle are found in Rediae, mainly in those of Echinostomes. Where they are found in conjunction with Sporocysts, they are only rarely found within them.

During the winter the Sporocysts are packed with germ-balls or half-ripe Cercariae. The vessels may then contain highly infected *Planorbis corneus* for weeks without showing Cercariae; then suddenly, when the barometer is high, a vessel may show milky water owing to the immense quantity of Cercariae. It is a characteristic feature that the broods in a Sporocyst are almost all in the same stage of development; in one half-grown, in another ready to be hatched. During the summer the Cercariae are born, ripen, and seem not to remain in the tissues of the snail, but immediately go into the open. —

The free life of the Cercariae lasts about 18—24 hours. After that the whole Cercaria-mass lies dead upon the bottom. On the other hand, there seems to be no doubt that the Cercariae are also able to encyst in the Sporocysts. Old snails which had thrown off plenty of Cercariae and had ceased to produce them often showed numerous cysts in the tissues; the singular thing was that they also occurred in the Sporocysts. Sporocysts were found which simultaneously contained cysts and Cercariae. This was especially the case when the snails were dead and then dissected. Cysts were also found in snails taken from their natural habitat and immediately dissected; this was especially the case with material gathered in January—February.

It would seem that Xiphidiocercariae, when the life conditions are unfavourable, are able to encyst in the primary host and even in the Sporocysts, but the numerous snails found with a Cercaria brood during the winter clearly show that this mode of propagation is not the normal one. —

Owing especially to differences in the size of the Sporocysts and to the different number of penetration glands as a rule, 4 but rarely 5 on each side of the ventral sucker, I have been in doubt as to whether there was not, in my district, more than one species of *Planorbis corneus* infecting Xiphidiocercariae. Furthermore the colour of the Sporocysts, the thickness of the paletot and the size differ from locality to locality. Nevertheless, I have provisionally referred all specimens from *Planorbis corneus* to this species. That there is in my area of exploration, a Xiphidiocercaria peculiar to *Planorbis corneus* is, as far as I have been able to see, beyond all doubt. —

Cercariae microcotyleae.

Cercariae microcotyleae was erected by Lühe (1909, p. 196) to include very small Distomes with the ventral sucker much smaller than the oral one, and situated behind the middle of the body. There are 2—4 penetration glands; the excretory bladder is small, bicornous. Sewell has subdivided it into four groups. The *Cellulosa* group, the *Pusilla* group, the *Parapusilla* group and the *Vesiculosa* group. Apart from the *Parapusilla* group, I think that they are represented in Denmark.

The Cellulosa Group.

Sewell (1922, p. 177) has erected the Cellulosa-group to include Loos' *C. cellulosae* and his *C. Indicae LVII.* It is mainly characterised by its extremely simple excretory system, and the fact that it has only two penetration glands on each side of the ventral sucker. With some doubt I refer a peculiar form found in *Paludina vivipara* to this group.

Cercaria cellulosa Loos. Host: *Paludina vivipara.*

Pl. XIV, figs. 5—8.

The whole body is covered with very small spines most prominent in the anterior part.

The dimensions are:

Cercariae.

	Living
Length of body	175
Breadth of body	95
Length of tail	145
Breadth of tail	25
Diameter of oral sucker	30
Diameter of ventral sucker	25

Sporocysts.

Length	1210
Breadth	680

The stylet has a feeble acute lateral enlargement; it differs a little in the dorso-ventral and the lateral aspect. The oral sucker is larger than the ventral one; the latter is situated a little behind the middle line of the body. There are on each side two penetration glands with granular protoplasm and large nuclei; they are placed before the ventral sucker. Their ducts pass forward to the anterior part of the oral sucker. Of the alimentary canal there seems only to exist a very small pharynx lying immediately behind the oral sucker. The excretory bladder is faintly bicornous. The two anterior excretory tubes divide into an anterior and a posterior branch; a posterior canal passes through the tail. The whole interior of the body is filled with greyish round bodies which look like oil globules and make it extremely opaque. The tail may be almost as long as the body but is often carried in a contracted state and is then only half as long.

When swimming, the Cercaria is broad, heart-shaped, but very variable in form. In the lateral aspect it is flat, curved, often so much that the forepart and hind part almost touch each other.

The Cercaria is developed in highly remarkable Sporocysts (Pl. XIV, fig. 7) of an irregular globular form, commonly one and a half times longer than broad; the colour was grey and the grey colour was inherent in small granules which formed a network over the Sporocyst; the paletot was very thick and consisted of flat cells with conspicuous nuclei (Pl. XIV, fig. 8). They gave the whole Sporocyst a scaly appearance. It contained 10—15 germ-balls or Cercariae in different stages of development. Almost always small flat Cercariae were found between the paletot and the very fine membrane which forms the wall of the Sporocyst. The host is *Paludina vivipara*. It was found in a pond at Hellebæk but only in one specimen out of several hundred (26/V 31). The Sporocysts were all found round the kidney, not in it, and they did not occur in the liver.

This very peculiar form seems to be identical with or very nearly related to *C. cellulosa* described by Loos (1900, p. 227, Pl. XIV, figs. 159—161) from Egypt. To this group Sewell (1922, p. 177) has added another *C. Indicae LVII* (Pl. XVIII, figs. 1—2) which also seems to be related to mine. Sewell shows that the excretory system in his species is of an extremely simple form, the flame cell formula being $2 \times 4 \times 1 = 8$ flame cells.

The vesiculosa group.

The *vesiculosa* group was erected by Sewell (1922, p. 195) to comprise small microcotyleous Cercariae with two groups of penetration glands, an anterior one consisting of one pair, and a postero-lateral one containing three pairs.

Cercaria vesiculosa Dies. Host: *Bithynia tentaculata.*

Pl. XIV, figs. 1—4.

The whole body is covered with asperities to such a degree that it has a brownish colour. The dimensions are:

Cercariae.

	Living	Preserved
Length of body	265	175
Breadth of body	70	110
Length of tail	255	150
Breadth of tail	15	20
Diameter of oral sucker	55	55
Diameter of ventral sucker	30	25

Sporocyst.

Length	335
Breadth	190

The stylet has a wing-like acute projection about one-third from the anterior end. The ventral sucker, which is almost only half as large in diameter as the oral one, is situated a little behind the middle of the body when the animal is contracted. Of the alimentary canal the only parts to be seen are a very small pharynx, the oesophagus and a glimpse of the intestinal coeca. There are two kinds of penetration glands, three pairs laterally to the ventral sucker and one pair before it, or four pairs in all. The three pairs have a very fine granular content and present themselves as rather bright cells; the fourth contains a much more granular protoplasm and is much darker. The ducts from the three pairs pass round the oral sucker and open near the stylet; the fourth at the base of the sucker. The excretory bladder is not round, globular, but when the animal is contracted, almost flat; when the animal is fully extended, it is bicornous. Anteriorly it gives off the two excretory canals which I have not been able to follow in their whole length owing to the opaqueness of the animal. There is a posterior excretory tube which passes through the whole length of the tail. This is subject to great variations in length. The Cercariae are hatched in small sausage-shaped Sporocysts about 2—3 times longer than broad; they contain 3 to 4 ripe Cercariae and several unripe ones. The host is *Bithynia tentaculata.* The species was only seen once in 5 specimens out of 30 from the borders of Tjustrup Lake on 8/VIII 32. The infected snails were twice as large as the uninfected ones. Besides the Sporocysts the liver also contained numerous cysts; one specimen had only cysts, another had Sporocysts as well as Cercariae and cysts. The posterior part of the liver mainly contained Sporocysts the anterior part cysts. Many of the Sporocysts contained cysts; this is shown in fig. 4.

It is with some doubt that I refer this species to the *vesiculosa* group erected by Sewell (1922, p. 195). According to him it should include his *Cercaria Indicae LI* and most probably *C. vesiculosa* Dies. It agrees with these forms on all essential points; only the bladder is not spherical as it should be in this group, but reniform and when the animal is fully extended, bicornous.

The pusilla group.

Cercaria pusilla Loos. Host: *Bithynia tentaculata.*

Pl. XIV, figs. 9—12. Pl. XV, figs. 1—4.

The cuticula is covered with very fine asperities. The dimensions are:

Cercariae.

	Living
Length of body	170
Breadth of body	75
Length of tail	150
Breadth of tail	15
Diameter of oral sucker	35
Diameter of ventral sucker	20

Sporocysts.

	Living	Preserved
Length	160	190
Breadth	80	125

The stylet has no conspicuous lateral thickenings; the oral sucker is much larger than the ventral one, which lies in the last third part of the body. There is a small pharynx, but of the rest of the oesophagus only a small tap. There are two large penetration glands on each side situated before the sucker; the anterior pair has a very granular content, both have large nuclei. The ducts pass forward along the edge of the anterior sucker, where they reach it, they have two peculiar appendages on their inner side. They were present in all specimens from three different localities. Their function is unknown; before the mouth is a small projection, not always present, and covered with fine spines. The contractile bladder is reniform; the two anterior excretory tubes pass forward to the ventral sucker and divide there into an anterior and a posterior branch; posteriorly there issues a tube running through the whole length of the tail. When the tail is fully extended, it is almost as long as the body.

The Cercariae are hatched in very small Sporocysts (Pl. XIV, figs. 9—12, Pl. XV, fig. 4), they are either globular or elliptical; they usually contain only one or not more than two-three ripe Cercariae and two to four germ-balls; if the germ-balls are very small, they contain five such. They were present in enormous masses; the whole liver almost only consisted of these small Sporocysts. Pl. XV, fig. 3 shows part of the liver filled with them. Some of them were, as in Loos's figures (Pl. XVI, fig. 178), conspicuously constricted; there can be no doubt that the enormous amount derives from partition. The host is *Bithynia tentaculata*, Hellebæk. It was found on 26/V 31 in three of twenty-five specimens, and occurred again on 3/II 32 in two of ten specimens.

It is only with hesitation that I refer this form to *C. pusilla* Loos. Apart from the peculiar appendage upon the ducts from the penetration glands it is in accordance with Loos's species on all other points.

Sewell (1922, p. 180) has created a special group of microcotyle Cercariae, the pusilla group. The main character should be three pairs of penetration glands, whereas the cellulosa group only possess two pairs. Sewell refers *C. pusilla* Loos to his pusilla group. Loos in his description does not mention the number of penetration glands, but his drawing (Pl. XVI, fig. 179) very clearly shows only two pairs.

As far as I understand, Loos pays no special attention to the number of penetration glands. At p. 228 he says with regard to *C. cellulosa* that the number is "le plus souvent trois de chaque coté".

Cercaria cordiformis n. sp. Host: *Bithynia tentaculata.*

Pl. XV, figs. 5—10. Microphoto XXXVIII, fig. 16.

The whole body is covered with fine asperities. The measurements are:

Cercariae.

	Living
Length of body	135
Breadth of body	55
Length of tail	45
Breadth of tail	20
Diameter of oral sucker	25
Diameter of ventral sucker	15

Sporocysts.

Length	400
Breadth	165

The stylet is somewhat broader one third below the tip. The oral sucker much larger than the ventral one, which lies in the last third of the body. No part of the alimentary canal has been seen. There are three penetration glands a little before and laterally to the ventral sucker on each side. The first pair is more coarsely granulated than the two other pair. The ducts pass forward and debouch near the stylet. Round the ventral sucker there are many small cells. The excretory bladder is reniform when the animal is contracted (Pl. XV, fig. 5), when it is stretched out bicornous, giving off the two excretory canals which on a level with the ventral sucker branch off in an anterior and a posterior branch. The excretory tube in the tail has not been observed with certainty. The tail when contracted is only one-third of the body length, when fully stretched out, longer than the body.

The Cercaria, when swimming, has a peculiar very broad form with a little tap anteriorly and the long thin tail incessantly whipping the water in large curves, Pl. XV, fig. 7. When creeping, the body is stretched out full length and the length of the tail reduced to one-third.

The Cercaria is hatched in very small elliptical, or almost globular Sporocysts containing 6—8 germ-balls and often three to four ripe Cercariae.

The host is *Bithynia tentaculata* and the species was found in different localities at Donse on 10/VII 31, at Hellebæk on 13/IV 31, at Arresø on 14/VII 31, at Vixømoor on 18/VII 31 and at Strødam 10/VII 31. In Hellebæk on 13/IV some snails were found in which the whole content of the liver consisted almost entirely of cysts present to the number of many thousands (Microphoto Pl. XXXVIII, fig. 16). It looks as if the whole mass of Cercariae had suddenly left the Sporocysts and immediately encysted. The same phenomenon was also observed on 10/VII in Donse material; of 42 snails three had cysts only, one had cysts and Cercariae. From Strødam (10/VII) 7 of 25 gave Cercariae. The snails then lived 8 days in the vessels, getting no food at all. 3 of the snails lay upon the bottom with closed shells. When dissected it could be shown that they were still alive, but Sporocysts and Cercariae were not observed. The whole mass of Cercariae had encysted, and the cysts were found as a cake of many thousands which covered the liver.

Cercaria virgulae.

Sewell (1922, p. 198) has divided this group into *C. virgulae* and *C. paravirgulae*. The former has no oesophagus and intestinal coeca; an oesophagus is present in the latter. Only the first group is found in our country. I do not agree with Sewell that the virgula group has no oesophagus. Like other rudimentary organs it seems to be developed in a very varying degree. Owing to the peculiar virgula organ the *Cercariae virgulae* are easily distinguishable from all other Xiphidiocercariae. It lies in the region of the oral sucker and consists of two pyriform sacs, fused together in the middle line; the narrow end points forward. The organ is of a refractive substance, it is hollow, with a cavity in the form of a narrow canal. The function of the organ is wholly unknown. It is only in the last part of the ripening process of the Cercariae that the organ is fully developed. In many specimens still lying in the Sporocysts it is not developed.

Common to all Cercariae virgulae is further the spinosity of the body and the fact that the ventral sucker, which lies a little behind the middle line, is smaller than the oral one. There is a well developed pharynx, but the rest of the alimentary canal seems to be but feebly developed. All European species develop in *Bithynia tentaculata* or *Paludina vivipara*, not in lung snails. —

Many forms are described, most of them very insufficiently; the two chief European forms are *C. virgula* Fil. and *C. vesiculosa* Dies. (Lühe 1909, p. 199). Dubois has added three helvetica forms: *C. helvetica VIII*, *C. helvetica IX* and *C. helvetica X*.

Cercaria nodulosa v. Linst. Host: *Bithynia tentaculata*.

Pl. XVI, figs. 1—4.

The body is covered with fine spines mainly in the forepart. The dimensions are:

Cercariae.

	Living
Length of body	280
Breadth of body	185
Length of tail	240
Breadth of tail	45
Diameter of oral sucker	65
Diameter of ventral sucker	45

Sporocysts.

Length	270
Breadth	210

As figs. 1—2 show, the body is extremely variable in form. After the large oral sucker follows a small pharynx. I have seen no oesophagus or intestinal coeca. The number of penetration glands is eight; two which lie before the ventral sucker and are always club-shaped; the other six lie laterally, behind the ventral sucker. When the animal is extended, they are also club-shaped, but when it is contracted, they assume a peculiar broad form (Pl. XVI, fig. 1). The excretory bladder is bicornous with the horns rather short. The two excretory canals divide in the middle of the animal, giving off one branch anteriorly and one posteriorly. From the posterior part of the bladder issues a branch which runs through the whole tail. —

The Cercariae develop in small, almost globular Sporocysts, which very often only contain one or two Cercariae, never more than four to six.

C. nodulosa develops in *Bithynia tentaculata* and is a very common form, observed in very many localities and at all seasons of the year. It has been regularly studied upon material gathered in the Hellebæk ponds.

About 100 *Bithynia* were dissected; one-fourth of the material was infected.

Like many of the other Xiphidiocercariae *C. nodulosa* are active swimmers, with some power of staying suspended in the water layers. The motion has been studied under the aquarium microscope. When the Cercariae want to ascend from the bottom, the body is curved to form a large bow with the opening upwards. It is then incessantly suddenly and vigorously turned alternately from one side to the other;

simultaneously the tail is moved with great force. The convex side of the bow is always turned downwards. During this motion the Cercaria ascends. When it has reached a certain height the tail is extended to its full length and is now motionless. The body stands still for a moment in the water layers, but then it begins to sink. When the bottom is reached, it rests upon its back; the tail is extended to its full length and the forepart of the body is slowly but regularly shortened and again prolonged. Suddenly the body is strongly bent, the tail moves, and the animal ascends straight as an arrow. The Cercaria uses about 30 seconds to ascend one cm. Now and then a Cercaria may be seen to ascend slowly in the water layers without any motion; I suppose this is due to variations of temperature in the vessels.

A vessel containing some *Gobio fluviatilis* received water which was rich in *C. nodulosa*. They did not show the slightest affinity for them. The fish swallowed one Cercaria after the other; 14 days later the fish were dissected, but no cysts were found. Simultaneously a *L. ovata* was put in a vessel containing several hundred Cercariae. The snail immediately began to secrete great quantities of slime, and the Cercariae were enclosed in it; several crept about on the skin and many were sitting on the shell, but no boring into the skin could be observed. —

In any case the Cercariae regularly leave the snails during the summer months; dissection is, however, always necessary in order to ascertain whether or not a snail is infected. I have had 9 *Bithynia* from a small pond in the Frederiksborg Castle Park (taken on 1/VIII 32) for two weeks in an aqurium; not one of them showed Cercariae; when they were dissected every specimen was seen to be heavily infected; the liver consisted almost entirely of small globular Sporocysts, each containing commonly not more than one or two not quite ripe Cercariae. —

When *Bithynia* have been kept for several months in aquaria and are then dissected, the liver often contains thousands of small hyaline cysts, with a stylet lying between the body and the wall of the cysts. These cysts come from Xiphidio-cercariae. I suppose that in this case the Cercariae have encysted in the snail itself; neither Cercariae nor Sporocysts were found. On 4/II 32, at a moment when the pond was just free from ice, 40 *Bithynia* were gathered; eight contained Sporocysts but in one of the snails the liver consisted almost entirely of cysts; no Cercariae occurred. The singular thing was that the liver contained some Sporocysts and in them were found globular cysts but always only to the number of one or two. It would seem that the encystation can take place not only in the snail, but also in the Sporocyst itself. This encystation in the snail may go on under unfavourable life conditions, as in the aquaria, or during the winter at low temperatures.

In *Bithynia* from the Hellebæk pond I have only found this species, so I regard it as highly probable that the cysts really belong to *C. nodulosa*. —

Cercaria virgula Fil. Host: *Bithynia tentaculata.*

Pl. XVI, figs. 5—6. Microphoto Pl. XXXVIII, fig. 13.

The Cercaria is perhaps not distinguishable from *C. nodulosa.* The dimensions are:

Cercariae.

	Living
Length of body	380
Breadth of body	190
Length of tail	190
Breadth of tail	50
Diameter of oral sucker	85
Diameter of ventral sucker	40

Sporocysts.

Length	900
Breadth	360

There is a well-developed pharynx; after it a small tip has been seen, but not intestinal coeca. It is difficult to see the number of penetration glands, but there are most probably more than eight, and these are arranged around the ventral sucker. They differ in form from those of *C. nodulosa.* I refer the reader to the two figures. The contractile vesicle has two very long horns.

The Sporocysts of the two species are quite different. They are elliptical (Pl. XVI, fig. 6), much larger than those of *C. virgula.* They contain not one to two but often about 100 Cercariae or germ-balls. — It is said to encyst in the larvae of Perlidae.

With certainty this species has only been found in the ponds of Strødam.

Cercaria helvetica IX Dubois 1929. Host: *Bithynia tentaculata.*

Pl. XVI, figs. 7—8.

The body is covered with fine spines. The dimensions are:

Cercaria.

	Living
Length of body	200
Breadth of body	90
Length of tail	80
Breadth of tail	30
Diameter of oral sucker	40
Diameter of ventral sucker	30

Sporocysts.

Length	250
Breadth	110

The species is very small; almost only half as large as *C. nodulosa* and *virgula*. The ventral sucker is only a little smaller than the oral one. There is a pharynx and an oesophagus; intestinal coeca have not been observed. There are eight penetration glands of an elliptical form, arranged round the sucker. The bladder is highly bicornous and the two horns almost reach the posterior pair of penetration glands.

The Sporocysts (Pl. XVI, fig. 8) resemble those of *C. virgula* but they are shorter and contain only eight to ten Cercariae.

The species was found at Værebroaa in North-Sealand 17/VII 31 5 of 20 *Bithynia* were infected.

Because of its small size it cannot be referred to *C. nodulosa* or *virgula:* Dubois (1929, p. 76) has described three new forms and with some doubt I refer this species to his *C. helvetica IX*; it is, however, much smaller.

Biological remarks.

1. As far as has hitherto been ascertained, the Xiphidiocercariae are all swimmers, and commonly bad swimmers. None of them have been observed to be pelagic, but a few of them seem to possess a slight floating power. In the vessels they mainly stand near the bottom; most of them show no special phototaxis and if they do so, they are chiefly negatively phototactic. Their life time as free-swimming organisms does not extend over more than about 24 hours. The swimming motion, during which the body is strongly contracted and the tail whips the water in all directions, is often soon replaced by the creeping motion during which the body is contracted and extended like that of a caterpillar.

2. It is characteristic of most of the Xiphidiocercariae that they are hatched in enormous amounts. The propagation of the Sporocyst by means of bud formation and partition must be immense. Indeed, there also occur Sporocysts which clearly show examples of both. The length of the divided parts differs from species to species. In some they have a length of several mm., in others, and especially among the Microcotyleae, they are almost isodiametric and exceedingly small. In accordance herewith the number of Cercariae in the Sporocysts differs greatly; in the long ones there may be many hundreds, in the globular ones only a few (2—4). Another characteristic feature is that the Cercariae in the long ones are almost all in the same stage of development. With high barometric readings, in bright sunshine, and mainly in the early hours of the morning the snail may throw out incredible numbers of Cercariae; in the course of an hour the water may become milky.

3. The whole development takes place in the Sporocyst; a sojourn in the snail outside the Sporocyst is not the rule.

4. On bright days when the snails lie at the surface among the vegetation, they are seen to be surrounded by white spots and by the leaves of *Potamogeton natans, Hydrocharis morsus ranae* and others. I would also refer the reader to the valuable laboratory observations of Dubois (1929, p. 113).

5. Encystment in the open has never been observed. In this respect there is the greatest difference between the Monostomes and the Xiphidiocercariae. The former so to speak dart towards the lighted sides of the vessels and encyst immediately; the Xiphidiocercariae are for a short time swimmers, then creepers; if they have not found an intermediate host in the course of 2—4 hours, they die.

6. The Miracidium, at any rate of some of the species, seems to me to show a remarkable affinity for special snails. I have never found *Cercariae virgulae* in other snails than *Bithynia*. *Cercaria vesiculosa* I have only found in *Bithynia*. In very small water ditches, where the surface was covered with leaves of water plants, and where a single sweep of the net gave about 20 old *Planorbis corneus* and as many *Limnaea stagnalis*, every one of the *Pl. corneus* would be infected with Xiphidiocercariae, whereas the *Limnaea stagnalis* did not harbour a single one, but contained immense quantities of Echinostomes (ditch on the moors near Hillerød (15/VII 31)).

7. With regard to the intermediate host the affinity for a distinct species does not seem to be very large. The provisional result that emerges is that encystation is commonly found among insects and snails or at all events invertebrates, more rarely among fishes. According to Mac Coy (1928 a, p. 220) a. o. tadpoles occur pretty often as hosts. But in this case too a predilection may be present. Xiphidiocercariae from *L. stagnalis*, *L. ovata* and *Planorbis corneus* were given *Corethra plumicornis* larvae and observed simultaneously, but only those from *L. ovata*. (*Cercaria limnaeae ovatae*) could use the larvae, none of the others. On the other hand, *Cercaria Haplometrae cylindraceae* from *Limnaea stagnalis* encysted immediately in the *Corethra* larvae, but with regard to this very species Lühe (1909, p. 106) says that the encystation takes place in *Ilybius fuliginosus*. Provisionally it may be assumed that the *Cercariae virgulae* mainly encyst in molluscs, especially in snails. Soparkar (1917, p. 512) has shown that a member of Sewell's *Polyadena* group (*Xiphidiocercariae Armatae*) *Cercaria Indica XVII*, encysts in *Anopheline* and *Culicide* larvae and that maturity is attained in fishes.

8. It is a well-known fact that the poultry in several localities (e. g. North Germany at the haffs) suffered from a Trematode disease first described by *Hieronymi* and Szidat (1921), later on by Seifried (1923), and Bittner (1923). For the literature see Szidat (1931 a, p. 293). The Trematoda occur in the oviduct; the eggs are laid without shells (wind-eggs); the infection is spread to the peritonaeum and the birds then die from peritonitis. Szidat (1926 b, p. 561 and 1931 a, p. 289) has shown that the intermediate carrier of the parasites are odonate larvae (*Libellula quadrimaculata* and *Cordulia aenea* in which cysts were found in 74 p. c.). The number of cysts varied from 1—70. Szidat has shown experimentally that the poultry fed with nymphs of *Cordulia aenea* were heavily infected and that the oviduct contained specimens of the Trematode *Prosthogonimus pellucidus* v. Linst. The primary host and the Cercaria itself are still unknown.

9. In a very interesting paper Wunder (1923 a, p. 68) has studied the phototaxis

of a xiphidioid Cercaria which he determines as *C. intermedia* nov. sp.; it is said to be intermediate between *C. armatae* and *C. microcotyleae;* it is stated to be related to *C. secunda* Ssin., the description is insufficient. Wunder comes to the conclusion that it does not find its host by chemotactic stimuli. At short distances it is unable to distinguish between plants and animals or between different animals; but it leaves plants or mollusc shells and stays on chitinous skeletons and tries to pierce them; there seems to be no special predilection for particular Arthropods. If the chitin is thin, as is the case with a *Corethra* larva or with the skin between the joints of the skeleton in many larvae of water insects, the secretion from the penetration glands is sufficient to pierce the skin; upon chitinous structures of a thicker consistency the stylet is used; the slime from the snails kills them. In the first case the process lasts only five minutes, in the second from $^1/_4$ to $^1/_2$ hour. When the parasite has arrived in the interior of the animal, the encystation takes place, and Wunder shows that the cyst wall may have a different appearance in the different hosts, hyaline in *Corethra*, pigmented in *Ephemeridae* and other insect larvae. The outer layer of the cyst is formed by the host. Even if the Cercariae are able to enter many different forms, the process of encystation is much easier in some hosts than in others; in this case it takes place most rapidly in the *Corethra* larva. — As far as I can see, it is Wunder's opinion that if the Cercaria has any predilection for a particular host, this is not because of chemotactic affinity but because the two factors have the same phototactic dispositions. In the present case this is so with *C. intermedia* and the *Corethra* larva. Both are negatively phototactic. Wunder shows this experimentally. At low temperatures (+ 4° C.) the *Corethra* larvae are not confined to negative phototaxis, whereas this is the case at higher temperatures (15—19° C.). Now if numerous Cercariae are kept in a flat watch glass (temperature 15°) they will move towards the darkened side; the *Corethra* larvae will do so, too, at high but not at low temperatures; at higher temperatures they will again and again mingle with the swarms of the Cercariae and at last be infected to such a degree that death is the result; at low temperatures many will escape this fate. Wunder further shows that, if the experiment is made in total darkness, the infection is not so great as in the light.

As far as I know, Wunder's experiments on the phototaxis of *C. intermedia* are the only ones of the kind which we possess, so they are of great interest. Of course they do not warrant any generalisation. —

10. From the observations described above, it will be seen that cysts of Xiphidiocercariae are a very common phenomenon in snails; the microphotos show that they may occur by hundreds. This has also been observed by Cort (1915a, p. 55), by Sewell (1922, p. 232) a. o. The question is whether these encysted Cercariae have left the snail, or encystation has taken place in the very snail in which they are born. From my own observations I am inclined to suppose that normally the Cercariae leave the snail and then again enter it. I have directly observed this for a Xiphidiocercaria hatched from *L. ovata;* it entered an *L. stagnalis* and encysted there. On the other hand, I think that the encystation in the very snail in which the Cercaria is

born is a very common phenomenon which mainly occurs under unfavourable life conditions, when the snail is badly fed, when it dies; it may apply especially to the last Cercariae hatched from the Sporocysts at low temperatures and which now hibernate as cysts in the same snail in which they were developed. Hence I think CORT's supposition (1915 a, p. 55) that the cysts which he found in the liver of *Limnaea reflexa* were really formed after the liver had been removed from the snail, quite correct. —

I am all the more convinced that CORT's observation is correct since I have made a quite similar observation without knowing CORT's paper. A *Planorbis corneus* was dissected; the whole liver consisted almost entirely of Sporocysts containing enormous amounts of Cercariae. The liver was cut off and put into a thermostat at 22° C. Two hours later the water contained enormous amounts of Cercariae. 8 hours later the Sporocysts were filled with cysts. First the tail was thrown off. It lay in the Sporocyst and retained its motion for a remarkably long time. Then a fine membrane around the Cercaria was observed and the stylet was found between the membrane and the Cercaria (observation 19/III 31).

Snails which I have had for months in the aquaria and which are infected with Xiphidiocercariae have very often great quantities of cysts in or on the liver round the intestine and even in the Sporocysts, while in snails taken in directly from Nature this is not often the case. Hence it seems to me to be in some degree an aquarium phenomenon, but under unfavourable life conditions it may also take place in Nature.

Chapter VI.

Macrocercaria.

Of all different groups of Cercariae the *Cystocercaria* as defined by LÜHE (1909, p. 201) is perhaps the most interesting, but perhaps also one of the most difficult and most heterogeneous. — It contains forms which, on a number of points, differ from all other Cercariae; the tail especially exhibits a specialisation not hitherto found in any of the other groups of Cercariae. Within the group itself this specialisation follows very different lines. This great variation is combined with very different forms of life either as true plancton organisms, as fixed bottom organisms in our ponds, or as anchored organsisms in mountain streams.

The group is extremely heterogeneous and it seems to me questionable whether it is a natural one. SEWELL (1922, p. 146) has withdrawn *C. mirabilis* and allied American forms from the *Cystocercariae* of LÜHE, and divided the others into three groups: 1. The *Gorgodera* group, 2. The *Gorgoderina* group, and 3. The *Appendiculata* group. SZIDAT (1932 b, p. 477) treats the *mirabilis* group in a special paper. He shows that the members, as already surmised by BRAUN (1891, p. 215) and by SEWELL (1922, p. 246), are true Furcocercariae, and refers the name *Cystocercariae* to this group alone, separating them entirely from all the other Cercariae with a tail of a cystocercous character. The reference of this group to the Furcocercariae seems all the more correct since the excretory system appears to be constructed in accordance with that of the Furcocercariae (Ward 1916, p. 14 for *C. anchoroides* and *C. wrightii*, Szidat 1932 b, p. 485 for *C. splendens*). Sewell therefore seems to be right in supposing that the cystocercous character of the tail in the *mirabilis* group may be merely an example of convergence, not of true relationship. The view of the *mirabilis* group as Furcocercariae is strengthened by Lutz (1931, p. 343) who maintains that the Cercaria of *Hemistomum trilobum* is a true transitional form between the Cystocercariae and the Furcocercariae. In this connection it may perhaps be convenient to note the fact that among the true Furcocercariae e. g. *Bilharziella polonica*, the body is deeply implanted in the basal part of the tail which swells on the sides of the Cercaria. The true cystocercous Cercariae pass a stage in the Sporocysts which seems to correspond with the stage at which these Cercariae of *Bilharziella* have stopped. Since our knowledge of the ultimate fate of the members of the *mirabilis* group is very restricted, I consider it most correct to regard it provisionally as a special group of Furcocercariae. It will be treated here under the name of *Cystocercaria*. —

The rest of the old group of the Cystocercaria may be divided into two groups. For the first group I propose to use Lühe's name *Macrocercaria*, the other group I propose to use the name of Ssinitzin *Cyrstropha*. In the Macrocercariae Lühe includes the two groups of Sewell, the *Gordodera* and the *Gorgoderina* groups. The tail is not of the furcocercous type. In its anterior end a cavity is formed which may endose the Cercaria body, but apart from this peculiarity, it is formed as a normal Cercaria tail, broadest anteriorly and tapering behind. The oral sucker is armed with a stylet bearing several spinose points. Penetration glands are present; they are composed of a different number of cells (4—12). The excretory bladder is very narrow, elongate, and almost reaches the posterior margin of the acetabulum. They develop in Sporocysts; host: *Sphaerium*. —

The mature forms are found in the urogenital sytem of *Amphibia*, mainly in the vesica. The Cercariae are sedentary, attached to a substratum, commonly the edges of the mantle of the *Sphaerium* from which they are hatched or at all events in very close proximity to the mussels. They only swim when obliged to do so; the apex of the tail is used as a sucker.

The European Macrocercariae may be referred to two groups proposed by Sewell (1922, p. 146). The *Gorgodera* group and the *Gorgoderina* group. The *Gorgodera* group may comprise the three following species:

C. Gorgoderae cygnoides. Zed.
C. Gorgoderae Pagenstecheri. Ssin.
C. Gorgoderae Varsoviensis. Ssin.

The *Gorgoderina* group: *C. vitellilobae* Ssin. The two groups may be distinguished from each other by the following characters: In the *Gorgodera* group the anterior chamber occupies not more than $^1/_6$, commonly not more than $^1/_{10}$, of the total length of the tail. In the *Gorgoderina* group it occupies about $^1/_3$. Further, in the *Gorgoderina* group, behind the cavity which is occupied by the body, there is a broad chamber containing numerous spherical cells. In Denmark both groups are represented. The *Gorgodera* group by *C. Pagenstecheri*, the *Gorgoderina* group by *C. vitellilobae*. —

Cercaria Gorgodereae Pagenstecheri Ssin. Host: *Sphaerium corneum.*

Pl. XVII, figs. 4—12. Pl. XVIII, fig. 3.

The dimensions are:

Cercariae.

	Living
Total length of body	4460
Breadth of "house"	450
Length of tail	3950
Breadth of tail	500
Oral sucker	60
Ventral sucker	70

The Cercaria without tail.

Length	600
Breadth	175
Oral sucker	120
Ventral sucker	100

The Cercaria may attain a length of 2—5 mm., the chamber including the Cercaria being only about $^1/_{10}$ of the total length. The chamber is formed as a duplicate of the cuticula; during the development in the Sporocyst it has grown up over the body and enveloped it. As long as the body is uninjured and undisturbed, it remains in the chamber, and always in a strongly bent position with the forepart almost reaching the bottom of the chamber. It may stretch itself halfway out of the chamber of its own accord, and again withdraw. It is fixed to the bottom by means of a very contractile muscle band. Under pressure the body may be forced out and it may then be seen how the duplicate of the chamber is rolled up and bent outwards (Pl. XVII, figs. 8—10). Then the body cannot re-enter its chamber, but is seen to move freely in the water attached by its muscle band. In Nature the Cercariae will be found on *Sphaerium* shells and on stones around them, and among them many with empty chambers, conspicuously showing the walls of the chamber, a fine cuticula bordering the space in which the body lived, and at the bottom of it remains of the muscle band which is now broken off. The chamber is connected with the tail in its whole breadth and there is no constriction between the chamber and the tail. The part of the tail nearest to the chamber is filled with numerous large cells with a hyaline protoplasm and rather small nuclei (Pl. XVII, fig. 9). The tail (Pl. XVII, figs. 4—5) itself shows a very conspicuous transversal muscle layer and two broad bands of longitudinal muscles which pass through the whole length of the tail. The interior is filled with a parenchymatous tissue consisting of rather few cells connected by long threads; the tail tapers towards the apex; it ends in a well-defined little sucker connected with the tail by a thin stalk. These structures are not conspicuous in all the Cercariae; they seem to be obliterated in specimens which have been killed after they have been removed from the substratum. — The tail itself is capable of very powerful motion. Attached to the substratum by the sucker, the 2 mm. long bodies move in large curves. It is a very peculiar sight to see a whole fringe of these hyaline threads always in motion projecting from the slightly open shells of the *Sphaerium* (Pl. XVIII, fig. 3). As soon as the *Sphaerium* is disturbed and shuts the shell, the Cercariae withdraw into the shell and disappear. Usually some of the Cercariae remain outside the shell. They may then be seen at the bottom of the vessel, indicating the *Sphaerium* which are infected. I have never seen a specimen which swam into the water of its own accord. When removed from the bottom, they swim in a lazy manner, but during the motion they sink slowly to the bottom, where they soon fix themselves again. —

Thiry (1860, p. 275) remarks that the locomotoric power of the larva, in spite of the very vigorous motion of the tail, is actually very small. This is correct, but I do not think he is right when he says: "Man würde nicht begreifen, wozu der ungeheure Schwanz vorhanden wäre, wenn seine Bewegungen nicht beim Bohren so vortrefflich verwendet werden könnten". I suppose that these bands and spots of a great number of Cercariae incessantly swinging in all directions are in the first place meant to bring the Cercariae into contact with the new host in which they are to encyst. When this is contrived, the Cercariae, which often sit halfway out the chamber, break off the connection with the tail and jump on to the new host. The many empty chambers would seem to render this supposition reasonable. It is a very characteristic feature that the tails with the empty chambers continue their swinging motion long after the Cercariae have left the chamber. I cannot see how the tail, as assumed by Thiry, can be an apparatus to facilitate a boring action. Thiry refers cysts which he has found in small *Limnaea* to this species. —

With regard to the body only the following points shall be mentioned. The oral sucker is only a little smaller than the ventral one. It is provided with a stylet which in the lateral view shows three teeth. Of the alimentary canal I have only seen a short oesophagus. By the sides of the ventral sucker there are pearshaped penetration glands whose ducts pass through the oral sucker and debouch at the posterior part of the stylet. Their number seems to be six on each side. The bladder presents itself as a long canal almost reaching the ventral sucker. It gives off two canals, which pass forward and, as far as I have been able to see, on the side of the ventral sucker divide into two branches, the one passing anteriorly the other posteriorly, and almost reaching the attachment of the tail. In its posterior part the bladder gives off a canal which runs through the whole tail but is difficult to see. It is correctly mentioned by THIRY. At the sides of the bladder lie 7 leaf-like cells which diminish in size posteriorly. They have a granular content, but nuclei have not been observed. Their function is unknown to me. —

The Cercariae develop in Sporocysts, which have been thoroughly studied by THIRY. — As WAGNER and later WUNDER (1924, p. 330) have observed, the Sporocysts never contain fully developed Cercariae, the chamber is not developed as long as the parasite is in the Sporocyst or in the mussel; it is not formed until the animal has left the mussel, and is hanging out of the opening between the two shells. With regard to the formation of the chamber I refer the reader to WUNDER (1924, p. 330) whose observations I can only confirm. —

C. pagenstecheri was only found once in *Sphaerium corneum* taken from a little pond (Vejenbrød) on 2/VI 32. The infection was very heavy, 30 of 50 specimens being infected.

Cercaria vitellilobae SSIN. Host: *Sphaerium.*

Pl. XVII, figs. 1—3. Pl. XVIII, figs. 1, 2, 4, 5.

The dimensions are:

Cercariae.	Living
Total length of body	1470
Breadth of "house"	230
Length of tail	920
Breadth of tail	135
Oral sucker	40
Ventral sucker	45
The Cercaria without tail.	
Length of body	405
Breadth of body	250
Oral sucker	75
Ventral sucker	85
Sporocysts.	
Length	1810
Breadth	210

The Cercaria is 1.75 to 2 mm. long, the chamber occupies only $^1/_3$ of the total length of the tail. The anterior part in which the body lies is of the same structure as in *C. Pagenstecheri,* but broader; behind this chamber there is in *C. vitellilobae* another, sharply marked off from the rest of the tail. The muscle which fastens the body to the tail passes through the whole length of this chamber, and is fastened to the anterior edge of the remaining part of the tail. This chamber is laterally built up of very large cells arranged transversally and with large nuclei (Pl. XVIII, fig. 2). The interior is filled with globular cells small in the anterior part and there densely packed. In the posterior part they are more scattered and here they are connected by long protoplasmatic threads. In contrast to *C. Pagenstecheri* the bodies are often stretched out almost at full length from the opening of the first chamber, and they are able to pass out and in at will (Pl. XVII, figs. 2—3). It may then be seen how the muscle band is now dilated, now contracted. When the bodies are stretched out of the chamber, the anterior duplicate is bent outwards; the body itself is commonly much bent and may move from one side to the other. Very often tails are found from which the bodies have disappeared, and in which the first chamber is rolled up and only the second chamber with loose threads of the muscle bands is present. These tails keep their locomotoric power for hours.

Just like *C. Pagenstecheri, C. vitellilobae* is a fixed organism attached to or in close proximity to the *Sphaerium* from which it has been hatched. As far as I can see, the tail has no sucker as is found in *C. Pagenstecheri;* its sides commonly present a series of curves whereas the contour in *C. Pagenstecheri* is straighter. The transversal as well as the longitudinal musculature is more powerfully developed, and this is the case, too, with the parenchymatous tissue. The tail therefore is more opaque and compact than in *C. Pagenstecheri* where the tail is very hyaline. It is traversed by the excretory tube the end of which has not been observed. By means of the relatively short but very muscular tail the animals are always in motion, swinging about incessantly and curving the tails and the outstretched bodies in all directions.

The body itself is subject to great variations in form.

The anterior and posterior suckers are almost of the same size. As far as I have been able to see, there is a short oesophagus without a pharynx, intestinal coeca have not been seen. Laterally and before the ventral sucker there are 6—7 cystogeneous cells. With long curved ducts they pass forwards, follow the borders of the anterior sucker, pass into it, and debouch on the posterior margin of the spine. The anterior part of this in the lateral view has three acute points separated from each other by a deep curve; the lateral wings are long. The excretory system is of a structure very similar to that of *C. Pagenstecheri,* a long bladder almost reaching the ventral sucker, and furnished laterally with a series of transversally arranged cells having a granular content with small nuclei. Two excretory canals issue from the anterior part; near the middle of the ventral sucker they seem to divide in an anterior and a posterior branch. There appear to be many vibratile tags, but they were not closely studied. Posteriorly the bladder gives off a tube which passes through the whole end of the tail; the opening has not been observed.

The Cercariae develop in Sporocysts (Pl. XVIII, fig. 4—5) which are attached to the gills of the mussels. They are of a peculiar, clumsy often very irregular form; they contain enormous quantities of Cercariae. In samples taken on 11/IV from Strødam, 16 of 50 *Sphaerium* had Sporocysts which contained immense masses of very unripe Cercariae. The Sporocysts were elongated sacs which were placed with great regularity side by side along the edge of the gills; a *Cyclas* might contain about 30—40 Sporocysts. On 5/VI, 4 of 20 *Sphaerium* contained Sporocysts and ripe Cercariae and on 20/IX 20 of 50 *Sphaerium* contained ripe Cercariae which soon appeared outside the mussels and sat swinging about at the edges of the mantle, on the shell or in close proximity to the mussels. None were seen to swim voluntarily.

Cercaria vitellilobae was found in *Sphaerium* on a moor near Hillerød on 2/IV 32, at Strødam where it is common the whole year round; and on 29/IX in Esrom Lake in one of 10 specimens. —

The third group for which I propose SSINITSIN's name *Cercaria cyrstropha* (1911, p. 20) consists of very aberrant forms; they are among the most marvellous of the freshwater larvae. Almost all the forms of this group have only been observed once or at all events at great intervals. The further evolution of these species is only known for a single form, *C. cystophora* Wagn. which develops in *Halipegus ovocaudatus* found under the tongue of *Rana esculenta*. Some of the forms are marine; one of these, *C. vaullegeardi*, seems to develop in Sporocysts, the others in Rediae; as far as hitherto recorded, they are all parasites on snails. It is the structure of the tail, divided into several parts of very different form and provided with various appendages of which we have no understanding at all, which gives these forms their different aspects.

The following species belong to this group:

Cercaria cystophora Wagener 1866. Europe.
— *yoshidae* Cort and Nichols 1921 = C. F. Yoshidae 1917. Japan.
— *capsularis* Sonsino 1892. Italy.
— *appendiculata* Pelseneer 1906, marine.
— *vaullegeardi* Pelseneer 1906, marine.
— *sagittariae* Ssinitzin 1911, marine.
— *laqueator* Ssinitzin 1911, marine.
— *indicae XXXV* Sewell 1922. India.
— *californiensis* Cort and Nichols 1921. California.
— *biflagellata* Faust 1926. South Africa.
— *projecta* Willey 1930. North America.
— *invaginata* Faust 1924.

As I have never seen any of these forms, and they have not been found in Danish freshwaters, they will not be treated here.

Chapter VII.
Furcocercaria.

As a result of my studies of Furcocercariae in Danish freshwaters the following remarks may be offered.

18 species have been observed. As far as I have been able to see, they may be referred to the following 7 groups:

1. The *Lophocerca* group.
   - *C. cristata.* La Val.
2. The *Ocellata* group.
   - *C. ocellata.* La Val.
   - *Bilharziella polonica.* Kow.
3. The *Bucephalus* group.
   - *C. Bucephalus polymorphus.*
4. The *Cysticercaria* group.
   - *C. splendens Szidat.*
5. The *Proalaria* group. Penetration glands behind the ventral sucker (host: Fish).
   - *C. I. Petersen.*
   - *C. C. Szidat.*
   - *C. helvetica XXXI Dubois.*
   - *C. longiremis n. sp.*
   - *C. F. I. Harper.*
   - *C. Frederiksborgensis n. sp.*
6. The *Strigea* group. The penetration glands before the ventral sucker. (host: Snails).
   - *C. letifera.* Fuhrmann.
   - *C. strigeae tardae.*
   - *C. A. Szidat.*
   - *C. linearis n. sp.*
7. The *vivax* group.
   - *C. vivax.* Sonsini.
   - *C. sp.*
   - *C. No. 4 Petersen.*

The Lophocerca group.

The genus *Sanguinicola* was erected by M. Plehn (1908, p. 427; 1915, p. 244) who found the two species *S. inermis* and *S. armata* in the blood of *Cyprinus carpio* and *Tinca vulgaris*. She misinterpreted the systematic position, and it was Odhner (1911 a, p. 33) who referred the genus to the digenetic Trematoda. See also Odhner (1924).

Relying on unpublished studies and drawings by Loos, Odhner (1911, p. 42) arrived at the result that the *Cercaria cristata* la Val. in capillaries of *Cypridinidae* develops in a species of the genus *Sanguinicola*. Scheuring (1922) and later on Ejsmont (1925, p. 877) showed that Odhner's supposition was quite correct.

The systematic position of the Lophocercariae has always been a matter of much controversy.

Lühe (1909, p. 175) placed them in a separate group. Sewell (1922, p. 22) placed them as the *Lophocerca* group under his Monostomata, whereas Miller (1926, p. 69) placed them under the Furcocercariae as *Apharyngeate brevifurcate monostome Cercariae.* In my opinion there are only two alternatives. Either, if we follow Lühe, to regard the Lophocercariae as a special group; or if we follow Miller to regard them as directly related to the Furcocercariae.

To include them in the Monostomata would be a great mistake in my opinion. In that case the Monostomata would include forms with an extremely different mode of life, both blood parasites and parasites of the alimentary canal; forms which pass a stage of encystment and forms without any stage of encystment and which pierce the skin of the final host. In accordance with the entirely different mode of life the anatomical structure of the two types is quite different. The Monostomata have no piercing organ, the oesophagus and diverticula are very well-developed; they have well-developed locomotoric pockets at the posterior angles of the body; the interior is packed with cystogeneous material and the excretory organ differs greatly from that of the Lophocercariae. Furcal rami are not present.

The only character which connects the Lophocercariae with the Monostomata is the absence of an acetabulum. From the Furcocercariae the Lophocercariae differ in the first place by the peculiar compressed body-form and the dorsal finfold, unique in its form and position among freshwater Cercariae, further in the bifurcation of the excretory canal in the tail-stem immediately at its base. As far as I know this trait, too, is unique among freshwater Cercariae. On the other hand, if the penetration apparatus as described by Sewell for his Indian material is common also in the European material the Lophocercariae agree with the Furcocercariae in that respect as well as with regard to the structure of the digestive tract. Another feature which they have in common is the development in Sporocysts not in Rediae as is the case with the Monostomata s. str.

It would seem, furthermore, that intermediate stages between Lophocercariae and Furcocercariae really exist. Sewell (1922, p. 57) mentions them; his Lophoides group may be regarded (1922, p. 58) as such, but I cannot find any form which connects the Lophocercariae with the Monostomata sens. str.

It may further be added that, according to Miller (1926, p. 68), the Lophocercariae is the only one of Lühe's groups which seems to be restricted to the old world; they have been recorded from Europe by many authors, from Asia especially by Sewell, and from Africa by Woodland (1923).

Hitherto the following Lophocercariae from freshwaters have been described.

Cercaria cristata. La Val. 1852.
— *microcristata* Ercol. 1881.
— *Sanguinicolae inermis* Scheur. 1922.
— *indicae IX* Sewell 1922.
— *indicae* XIII Sewell 1922.
— *indicae XXXIX* Sewell 1922.

Cercaria indicae LV Sewell 1922.
— *Sanguinicolae* spec. *Bithynia leachii* (Ejsmont) 1926.
— *Sanguinicolae* spec. *Limnaea stagnalis* (Ejsmont) 1926.
— *helvetica XVI* Dubois. 1929.

The Indian fórms described by Sewell differ from the European forms in many essential particulars. *C. indica XIII* may be the form most nearly related to *C. cristata,* but it differs from it by having very small and never filiform Sporocysts and by its smaller size. Dubois's species *helvetica XVI* differs from all other species in the reduction of the fin membrane of the body and because the fin membrane of the furca is absent in the first third. It is found in *Limnaea limosa* (= *ovata*).

With regard to the other species I refer the reader to Ejsmont's paper of 1926 (pp. 928—942). The said species all seem to differ very little from each other; well-defined morphological differences have not been found. They occur in different snails *Limnaea stagnalis, Limnaea auricularia, Valvata piscinalis, Bithynia Leachii, Paludina impura, Planorbis submarginalis, Bithynia tentaculata, Cleopatra bulimoides.*

It is possible that the two species: *C. cristata,* mainly found in *L. stagnalis* but also in *L. auricularia* (Loos, Scheuring) and *C. microcristata,* found in *Bithynia tentaculata* have species range. With regard to the other species, the differences are probably due to the fact that the forms are found in very different snails.

Cercaria cristata La Val. Host: *L. stagnalis.*

Pl. XX, figs. 1—10. Microphoto Pl. XXXIX fig. 22.

The dimensions are:

Cercariae.

	Living
Length of body	95
Breadth of body without membrane	30
Greatest height of membrane	25
Length of tail	240
Breadth of tail	25
Length of rami	115
Breadth of rami	20
Oral sucker	20

Sporocysts.

Length	19200
Breadth	600

The crest reaches from the penetrating organ to a little before the attachment of the tail, the height differs from specimen to specimen. —

The protrusile penetrating organ is bluntly conical, divided from the body by a conspicuous constriction. The extreme tip is provided with a pair of conical spines, most probably hollow, and acting as a piercing organ. More than two spines have not been observed. The hairs or papillae which, according to EJSMONT (1926, p. 935, text-fig. 10) are regularly arranged in circles round the cone, I have not seen, perhaps because I have only looked for them in preserved formaline material. His view of the cone as a snout ("Rüssel") capable of great telescopic contraction and extension, I can fully confirm. Figures 2—5 show the same animal drawn in the course of two minutes. The snout is extremely mobile, capable of being withdrawn into a kind of sheath, to be protruded again the next moment at full length. Of the penetration glands I have only observed two fine strings. As far as I know, only SEWELL (1922) has observed the glands in his Indian material of Lophocercaria. Only EJSMONT (1926, p. 938) has seen the oesophagus and stomach. He contends that diverticula to the number of four appear "erst später". The digestive tract has been very difficult to observe and I have not ventured to draw the oesophagus. No eyespots have been seen. SEWELL (1922) maintains them for all Indian species. The excretory organ consists in a bladder which is often difficult to see and whose form varies greatly. It sends forward two main trunks which reach the piercing organ. I have been unable to see the flame cells observed by SEWELL in his Indian material. The formula is said to be $2 \times 3 \times 1 = 6$.

With regard to the excretory system in the tail stem, Loos's drawings in ODHNER's paper (1911, p. 43) show two canals, and EJSMONT arrives at the same result (1926, p. 941 and fig. S, p. 939); the two canals pass into the furcal rami, where they open at the base of a small tip. Curiously enough, SEWELL (1922) draws in all his figures only one caudal excretory canal. As far as I know, two canals in the tail stem are a unique trait in the structure of the Cercariae, though I cannot but think that the drawings of Loos and EJSMONT are correct; my observations are in accordance with the two last authors. Nobody has observed flame cells in the tail stem. The interior of the body, more especially the bent part, is filled with round cells; many of them are remarkably large and furnished with a big nucleus and numerous yellow granules which impart a yellow tinge to the whole body.

The tail stem is in preserved material constricted at its base. Slanting muscles run in two directions, crossing each other. The furcal rami are well-defined at their base, and the rather broad finfold only reaches the place of attachment of the rami to the stem.

The species here described may be referred to *C. cristata* La Val. The measurements agree well with it. It is the only form in which long filiform Sporocysts are found. The only difference from those redescribed by EJSMONT is that they may be much longer, and that the Cercariae are not deposited in a single long row.

Sporocysts. A *L. stagnalis* from 24/III 30, which died on 28/III, was dissected immediately after death. The surface of the liver was covered with numerous small yellow, cushion-formed spots which, when opened, proved to consist almost entirely of Cercariae that appeared in the water in enormous amounts. Below the cushions were found layers of shorter Sporocysts. The liver was, however, mainly characterised by a great number of long yellowish-white threads with a length of about 1—2 cm. These Sporocysts were chiefly placed on the surface of the liver. When they were loosened, it could be seen that they were fastened by means of a sucking disc provided with strong muscles. Sucking discs have only rarely been observed in Sporocysts.

Among the Sporocysts one was found (Pl. XX, fig. 6) on which the sucking disc was especially well developed (Pl. XX, fig. 10); the skin was remarkably thick and somewhat opaque length 1.90 cm. While watching it, I suddenly saw a long thin Sporocyst make its way through the skin. A few minutes later another arrived in another place, and now everywhere there appeared through the skin, now here, now there, a young Sporocyst which swam away very actively from the mother Sporocyst (fig. 6). The Sporocyst was now studied more thoroughly. Owing to the thick skin and its length I regard it as a mother Sporocyst. It contained brood of three different kinds. 1. The above-mentioned long daughter Sporocysts (600—1000 μ) which were all packed with almost iso-diametrical germ-balls. The number of these daughter Sporocysts was not more than 30—40. 2. An enormous amount of small Sporocysts not more than twice as long as broad (length: 112—150 μ). These Sporocysts contained about 10—12 Cercariae in different stages of development; they are not shown in fig. 6 but in fig. 7, which exhibits part of the same Sporocyst that is figured in 6. 3. Free-lying germ-balls, many of which plainly showed a cleft tail, that is to say Cercaria brood. That a Sporocyst contains simultaneously daughter Sporocysts and Cercariae is nothing remarkable, but the curious thing is that it contains two kinds of Sporocysts, one sort long, packed with very small germs, and leaving the mother Sporocyst everywhere through its walls, and another sort only twice as long as it is broad, and producing Cercariae. As shown in fig. 7, the Cercariae were found lying free in the mother Sporocyst; when it was pressed, they made their way out by piercing the skin. The mother Sporocyst itself was inactive, only the forepart incessantly altered its form. Fig. 8 shows the tip. This forepart, of a greyish tinge, was the only part which did not contain brood.

Sections of the liver show that the whole of it, especially near the edges and in islets corresponding to the cushions on the surface, consists almost entirely of these small bodies.

As far as I can see, the rather complicated development may be interpreted as follows. The 1.9 cm. large Sporocyst is the metamorphosed Miracidium with which the snail was once infected, most probably in 1930. This mother Sporocyst then produced a great number of daughter Sporocysts, 650—1000 μ in length. Most of them fastened themselves to the surface of the liver, imparting to it a floccose appearance. The mother Sporocyst as well as the daughter Sporocysts produced an immense quantity of small oval Sporocysts, not more than 112—150 μ long. The mother Sporocyst therefore produces two kinds of Sporocysts, those 650—1000 μ long, and those only 112—150 μ long. The long daughter Sporocysts, as far as I can see, only produced the latter kind. The long daughter Sporocysts pierce the walls of the mother Sporocyst, making their way partly through them and partly through the liver of the snail, the small ones are only liberated by rupture of the Sporocyst in which they have been nourished. When the investigation began, the parasite was using all its energy for the production of Sporocysts, and the development of Cercariae had only just started.

Cercaria cristata was found in four different localities. In two of them (Langesø and Sjælsø) they were found in *Limnaea stagnalis,* always in old, very large specimens. In the other two they were found in *Valvata piscinalis* and *Bithynia* (Furesø) and in *L. ovata* (Teglgaardsø). All observations date from the months of June—September. Apart from the specimens from *Bithynia* and *Valvata,* which are derived from Furesø at a depth of 3—5 m, the others all come from ponds and small lakes. The snails were always infected in very small numbers; of *L. stagnalis,* for instance, 1 in 17, of *Valvata* 1 in 50.

One of the *L. stagnalis* was put into the largest of my aquaria in October 1930. I did not know that it was infected, but when it was put into a small vessel on 24/III and placed in a thermostat at 22° C., it immediately threw out an immense quantity of *Lophocercariae.* On 28/III it died. Most of my observations originate from this snail and from those from Langesø where I gathered fresh material during the last ten days of June 1932. The snail proved to be heavily infected. In the course of 24 hours the water in the vessel was filled with numerous Cercariae. These Cercariae were typical plancton organisms, remaining suspended in the water layers. I refer to Chap. VIII. Suspended in the water layers, they are unquestionably apt to come into contact with fishes of the family *Cypridinidae.* In my aquaria the life-time of the Cercariae has never been more than 24—30 hours. Into two of my aquaria, containing two snails heavily infected with *Lophocercariae,* I put two *Carassius,* but curiously enough, no special affinity could be observed. The two *Carassius* lived for half a year and on dissection showed no worms in the heart and no eggs in the gills or in the blood. This has troubled my a good deal because Ejsmont, at Warschau, found the parasite in 55 out of 250 specimens of *Carassius.*

On 21/VI a *Limnaea stagnalis* was found in a pond, Langesø. It immediately produced myriads of *Lophocercariae.* In the course of 24 hours the water was a milky white. It was changed every evening, and every morning it was again milky. This was repeated until 28/VI when the *Limnaea* was dying. The appearance of the liver now differed greatly from that of the specimen in March. It was a yellow mass, containing as it were exclusively Cercariae, which poured out in a broad yellow stream when the liver was ruptured. It was almost impossible to see any Sporocysts; long ones were absent, and the liver itself was in putrifaction in the upper part, nevertheless the snail was still alive when it was dissected.

The Ocellata group.

Only four species belonging to the *ocellata* group (Miller's apharyngeal-brevifurcate Furcocercaria) have hitherto been recorded from Europe. They are *C. ocellata* La Val. 1855, *Bilharziella polonica* Kow. 1896, *C. macrosoma* Brown 1926, and *C. echinomorpha* Brown 1931. The two last-named species are very nearly related to *C. ocellata,* with which they seem to agree in all essential particulars. Only the two first-named have been found in Denmark. With regard to the difference in the structure of the penetration glands (Acidophile and basidophile glands) I refer the reader to Faust (1919 b, p. 164; 1920 e, p. 192; 1922 a, p. 11; 1926, p. 101).

Cercaria ocellata La Valette 1855. Host: *Limnaea stagnalis, L. ovata.*

Pl. XXI, figs. 1—4. Pl. XXVIII, figs. 7—9.

Cercaria ocellata was first found by La Valette de St. George in *Limnaea stagnalis* in the neighbourhood of Berlin. It was described in 1855 (p. 123). It was not recorded again until 1902, and described by Ssinitzin from Warshaw (1910). It was found again by Dubois (1929, p. 96) in Switzerland. It was further recorded by Vogel from the environs of Hamburg (1930 a, p. 577; 1930 b, p. 1), by Brumpt from France (1931 a, p. 612, and 1931 b, p. 253), and by Taylor and Bayliss from the neighbourhood of Cardiff (1930, p. 219). It is nearly related to, if not identical with *Cercaria elvae* described by Miller (1923, p. 35, and later on 1926, p. 30), and later on from Michigan by Cort (1928 a, p. 1027; 1928 b, p. 388). The principal host seems to be *Limnaea stagnalis,* but Mathias (1930 b, p. 152) found it in *Limnaea ovata,* and Brumpt has shown experimentally (1930 a, p. 614) that it may infect 7 different species of molluscs. There was great affinity for *Planorbis corneus* (?), *P. rotundatus,* and *Limnaea palustris.* Only *Bithynia tentaculata* could not be infected. It has been confounded with *Bilharziella polonica,* whose chief host is *Planorbis corneus* (Ercolani 1881). —

The dimensions are:

	Living	Preserved
Length of body	350	273—314
Breadth of body	90	51—71
Length of tail	365	292—386
Breadth of tail	45	34—47
Length of furca	260	199—274
Length of anterior organ	85	37—56
Breadth of anterior organ	65	33—46
Length of ventral sucker	35	13—24

Fully extended, the body and tail are almost equally long; when the animal is not fully extended, the tail is longer than the body. The furca is shorter, but has great power of contraction and expansion. The rami may attain more than two-thirds of the length of the tail, but commonly they are not more than half as long. The breadth of the tail may equal that of the body. The ventral sucker is capable of being protruded much more than in any other Cercariae (Pl. XXI, fig. 3). It is for this reason that slides almost always show lateral views of the animal. When the sucker is extended, a complicated system of muscles running from it to the dorsal side causes the forepart of the body to bend downward and form a sharp angle between the sucker and the anterior organ. The part behind the sucker is almost unaltered. This action of the muscles alters the whole aspect of the animal in a way that I have not hitherto observed in any other Cercaria. The body tapers towards both ends. It is broadest above the sucker, and tapers most anteriorly, where it shows a somewhat rounded snout. The body is divided by a chitinous fold, the forepart containing most of the anterior organ to which several muscles are fastened. The whole body is almost quite smooth, only the part before the chitinous fold shows a fine striation, which may perhaps be interpreted as extremely fine spines arranged in longitudinal lines. Special thorns on the apex were not observed.

The anterior organ is very large and divided into an anterior, more thin-walled, and a posterior very muscular part, which is very conspicuous owing to its transversal muscle threads. A conspicuous sack-like head gland is situated over the organ. In side view the organ is pear-shaped, with a faint curve below and tapering anteriorly. The ventral sucker is situated in the last third part of the animal. It can be entirely withdrawn into the body, and it can be protruded to such an extent and the body bent sideways so far that it becomes twice as broad as usual and is shortened by more than a third. In the ventral view it shows a peculiar chitinous structure (Pl. XXI, fig. 1); the lateral aspect shows concentric circles of very minute spines, and below the cuticula fine circular muscles. The actual sucking part can be withdrawn and extended telescopically, and a system of muscles running through the body is fastened at the point where the cuticula is folded. The muscles consist mainly of two groups of fine threads attached by the other end to the dorsal wall of the body.

Anteriorly, laterally, and posteriorly lie the powerful penetration glands, filling most of the interior with their ducts. There are five pairs of glands, three smaller posterior ones and two much larger ones, of which one mainly occupies the space round the sucker, the other that before. The two groups differ much in appearance. The body of *ocellata* being marvellously transparent with only a faint yellowish tinge, the whole penetration apparatus may be observed very plainly. The two anterior pairs of penetration glands have a coarsely granular protoplasmatic content; the three posterior pairs are of a more greyish colour and have a protoplasmatic content consisting of a much finer granular mass. The two anterior pairs may almost be said to be chromophobic, the three posterior pairs stain very deeply with haematoxyline. The nuclei are always situated in the posterior part of the cells, but are larger in the anterior than in the posterior pairs. The very strong ducts constitute a highly remarkable feature. With regard to the two anterior pairs it is almost impossible to say where the cells stop and the ducts begin.

Viewed from above, the ducts show a very characteristic course, common to the many hundred specimens observed. It is most distinct in the two anterior pairs. First the ducts bend outward, then inward, so much so that they almost touch each other, then outward again; shortly before they reach the anterior organ, they again bend inward. They then traverse the anterior organ, ending at the apex where there occur six small protuberances, the openings for the ducts. Of their number I am not quite sure; six at all events, are present, but more probably ten. When the body is extended, the course of the ducts is curved, when the body is bent, as shown in Pl. XXI, fig. 3, the curves are much steeper. This is especially the case in the anterior organ where the loops almost reach each other. When the Cercaria has remained in this position for a few seconds, a clear jelly-like mass is seen to pour out from the apex and now remains glued to the forepart of the body (Pl. XXI, fig. 3). Tanabe (1923, p. 184) has made the same observation with regard to *Schistosoma pathlocopticum*. It can further be shown that throughout the curves muscle threads run from the ducts either to the skin or to the chitinous list which separates the forepart from the other part of the body.

The alimentary canal is extremely reduced; there is merely a staff-like oesophagus, only reaching a little more than halfway between the anterior organ and the sucker. It divides into two short protuberances all that is left of the intestinal coeca. There is no pharynx. Simultaneously with the reduction of the alimentary canal, the penetrating organs have undergone an enormous development which is unique in this group.

The visible part of the nervous system consists of a somewhat x-shaped greyish mass, situated just in front of the eyes. There are two eyespots, consisting of numerous granules of a brownish-red colour, and before them a well-developed protruding lens.

The bladder is very small. Anteriorly it gives off two excretory canals, posteriorly one, which passes into the tail. On reaching the ventral sucker, the two anterior canals divide into an anterior and a posterior branch. The former carries three flame cells, the latter four, one of which is situated in the tail. The excretory tube in the tail bifurcates before the furca, and the two rami open on their tips. The tail has a layer of circular and longitudinal muscles and, along the excretory tube, a series of globular bodies only observable in living material.

The Cercaria develops in very long Sporocysts (Pl. XXVIII, figs. 7—9), extremely variable in form. Greyish narrow parts alternate with very broad transparent ones, real brood chambers packed with brood. Old Sporocysts consist mainly of narrow greyish parts with a few fully developed Cercariae. A birth pore has not hitherto been observed.

In Denmark *C. ocellata* has so far only been found in one pond in the castle grounds of Hørsholm. It was found in *Limnaea ovata* as well as in *L. stagnalis* but not in the *Planorbis* species. The number of infected specimens was always small, one in ten. Material was gathered on 8/X 31, when the first infected snail was found. In 1932 material was collected on 23/V, 2/VII, and 16/VII. In May the material consisted almost entirely of Sporocysts, on July 16th almost exclusively of Furcocercariae. Some snails were found which almost exclusively harboured Cercariae, and in incredible amounts. These snails had a peculiar yellow colour. A snail taken on 2/VII every day gave off enormous amounts of *C. ocellata*, which gave the water a greyish colour. It died on 16/VII.

Cercaria Bilharziellae polonicae Kow. Host: *Planorbis corneus*.

Pl. XXI, figs. 5—7. Microphoto, Pl. XXXVI, fig. 5.

The dimensions are:

Cercariae.

	Living	Preserved
Length of body	305	185—232
Breadth of body	110	82—87
Length of tail	275	242—266
Breadth of tail	45	25—36
Length of furca	110	77—107
Length of anterior organ	80	44—57
Breadth of anterior organ	65	..
Length of ventral sucker	45	34—46

Bilharziella polonica was found by Kowalewski (1895 p. 1 and 1896, p. 146); later on by Szidat (1928 a, p. 331).

So far the Cercaria has been found by Szidat (1929 b, p. 78; 1929 c, p. 461) in Kurische Nehrung. It occurred in *Planorbis corneus*, but was extremely rare, only 4 cases in 600 snails, that is, a percentage of only $^3/_4$—1. In the above-cited papers Szidat has worked out the anatomy and the biology. Further it was found by Brumpt (1931 b, p. 253) in *Planorbis corneus* originating from small brooks in the Bois de Boulogne. Here, too, it was very rare, occurring only in 6 specimens out of 614. It seems highly probable that the Cercaria found by Ercolani (1881) in *Planorbis corneus* belongs to this species and not as he supposed to *C. ocellata*.

Fully extended the body and tail are almost equally long; the furca is very short, about one-third of the length of the tail, but when fully extended one-half. It has a conspicuous fin membrane. The body is broader and the tail shorter than in *C. ocellata*. The tail shows a peculiar feature. In its anterior part it is expanded wing-fashion, while the body has a cup-like depression. This feature differs very much from specimen to specimen and may be very pronounced or almost absent in preserved material. The tail breaks off very easily.

In the anterior part the body is covered with fine spines, coarser nearest the apex, inconspicuous in the posterior part. The anterior organ is large and divided into an anterior more thinwalled and a posterior very muscular part. The muscle threads running transversally are very conspicuous. In side view the organ is somewhat pear-shaped, but the curve below is not so pronounced as in *C. ocellata*. A head gland was not observed. Szidat (1929c, p. 465) has "nur geringe Andeutungen erkennen können". The ventral sucker lies behind the middle line; it is not capable of protrusion in so high a degree as in *C. ocellata*. In the ventral aspect it shows a similar chitinous structure surrounding the opening as in *C. ocellata*, and here, seen laterally, it has concentric circles of very minute spines and, below the cuticula, fine circular muscles. The actual sucking part of the sucker can be withdrawn telescopically and again protruded. At the point where the cuticula is folded, is fastened a system which runs transversally through the body. Antero-laterally there are two pairs of penetration glands, posteriorly four; the two first-named pairs have a clear bright protoplasm, the four behind are more greyish and have a granular content. Only the four posterior pairs are chromophilous, the two anterior pairs are not. Szidat found three pairs behind and three pairs before the sucker (1929c, p. 463).

The ducts show a course very similar to that in *C. ocellata*, but the ducts from the single cells seem to be separated from each other by rather large crescent-shaped spaces. They are not so broad as in *C. ocellata*, and the ducts from the two sides do not reach each other. In the lateral aspect, as seen in the drawing (Pl. XXI, fig. 6), they approach the ventral side immediately before entering the anterior organ (on the boundary line between the two parts), whereupon they ascend dorsally. In loops they reach the tip of the anterior organ, and open there on a series of small protuberances. The alimentary canal is much reduced; it is rod-like and only reaches halfway from the anterior organ to the ventral sucker; of the intestinal coeca only two small buds are present. The visible part of the nervous system is a greyish mass lying just in front of the eyes. There are two eyespots of the same form and size as in *C. ocellata*. Szidat (1929c, p. 464) has seen four pairs of sensory papillae on the body. These papillae I have overlooked. The bladder is small. When the two anterior canals reach the ventral sucker, they divide into an anterior and a posterior branch; at the point of division a transversal branch passes out below the ventral sucker. I do not know whether there is a real transversal commissure. The excretory tube in the tail bifurcates before the furca, opening on the tips.

The animal is not so transparent as *C. ocellata*. Hence it is more difficult to see the flame cells; they are most conveniently studied in the lateral aspect. As far as I can see, the anterior branch drains three flame cells, and the posterior four, with the last pair in the tail.

The tail has a layer of circular and longitudinal muscles. If globular bodies are present, they are only faintly developed. The Cercariae develop in very long Sporocysts very similar to those of *C. ocellata*.

The host is *Planorbis corneus*.

Bilharziella polonica has hitherto only been found in three localities: Torkeris Pond near Hillerød, Hørsholm Pond, and a small pond near Steenstrup (Sorø). It was found in Torkeris Pond on 5/V 31 in one specimen out of 10, and on 4/VII 31 in several specimens; on 23/IX again in several specimens out of 30. Later on it did not occur. In 1932 more than 100 *Planorbis corneus* were observed, but not a single Furcocercaria with eyes was found. On 7/VIII it was found in a few specimens at Steenstrup, on 11/VIII 32 in one out of 25. Finally, in Hørsholm Pond 1 specimen of *Planorbis corneus* was found on 5/VII 32 and proved to be infected with *Bilharziella*. Again, on 8/VII, a single specimen was found, which was likewise infected. On 27/VII 32 one of 7 specimens was infected. *Planorbis corneus* is very rare in the pond.

The Bucephalus group.

(Subordo Bucephalata).

As is well known, ODHNER (1905, p. 291), owing to insufficient evidence with regard to the life history and development, placed the *Gasterostomes* in a separate order. LA RUE gives good reasons for the supposition (1926c, p. 273) that there is a relationship between the *Strigeidae* and the *Gasterostomes*.

SSINITZIN (1910, p. 299), comparing the Cercaria of *Bucephalus haimeanus* with that of *C. ocellata*, arrives at the conclusion that the tail of *Bucephalus* is homologous with that of the *Furcocercaria*. At a certain stage in the development of the tail it has almost the same aspect; the whole difference may be referred to inequalities of growth, a strong development of the tail stem in the Furcocercaria and a reduced development of it in the *Bucephalus*, combined with a very strong and peculiar development of the furca.

Bucephalus polymorphus BAER. Host: *Anodonta*.

Pl. XXX. Microphoto Pl. XXXIX, fig. 26.

About 50 *Anodonta* from different localities in the neighbourhood of Hillerød were dissected. Most of them came from Furesø, a few from Esromsø, and several from the Hørsholm ponds. In none of them were *Bucephalus* observed. I had hoped to find at the same time the very peculiar *Cercaria duplicata* described by v. BAER (1827 p. 558) and later on by REUSS (1903 p. 458), and WUNDER (1924a, p. 323) but, to my regret, not a single specimen was found. The Cercaria is enclosed in a hyaline cyst which is expelled by *Anodonta*, being then found as "Glaskugeln" at the bottom of the water. "Bei der geringsten Strömung sehen wir die leichten Kugeln dahinschweben. Die Verbreitung ist also hier passiv wie bei einem Pflanzensamen" (WUNDER 1924a, p. 329). In one of my aquaria two *Anodonta*, most probably coming from Hørsholm Pond, had hibernated. On 14/V 33, *Bucephalus* larvae suddenly appeared. The aquarium was placed at the window in bright sunshine, and the next day many *Bucephalus* larvae were observed.

I have nothing to add to the numerous descriptions of these very interesting larvae. With regard to the anatomy I refer the reader to ZIEGLER (1883, p. 537), with regard to the biology to WUNDER (1924a, p. 302 and 1924b, p. 289), and with regard to the Miracidia, encystment and Sporocysts chiefly to Woodhead (1927, p. 232; 1929, p. 256; 1930, p. 1; 1931, p. 169).

By means of a cinematographic camera Wunder has taken a series of moving pictures and in this way elucidated the manner of locomotion hitherto misinterpreted or not understood. I am convinced that Wunder's explanation is correct, and having now studied the mode of locomotion partly by means of the aquarium microscope and partly by means of an Edinger apparatus, projecting the picture on to a white screen, I presume that I should have arrived at the same result. I refer to table XXX with description. Having worked for years with plancton, studying especially the locomotion and suspension of plancton organisms, it is of especial interest to me that Wunder, as far as I know without knowledge of the literature on the subject, has arrived at exactly the same result with regard to the floating power of *Bucephalus* as I have with regard to other plancton organisms, especially the Cladocera and the Rotifera. Among all the Cercariae the *Bucephalus* larva is the most pronounced plancton organism hitherto known. Its home seems to be the midmost water layers where, by its peculiar manner of locomotion, it attracts the attention of *Cyprinidae*, especially *Scardinius erythrophthalmus*, in which it encysts. The following is an abstract of Wunder's paper combined with an account of my own observations.

I regard the *Bucephalus* as a Furcocercaria with reduced tail stem and a strongly developed furca. The power of extension and contraction is common to all Furcocercariae, but here it is developed in a much higher degree than in all hitherto known Cercariae. The position of the animal is the same as in other pelagic Furcocercariae, the furca being turned upwards and the Cercaria body downwards. However, whereas the plancton Furcocercariae hold the furca horizontally and keep it motionless, it is here held almost vertically and capable of great extension and contraction. As pointed out by all other observers, it is in these long rami of the furca that the power of locomotion is seated. The animal is so to speak in incessant motion, though it stands in nearly the same spot in water layers which are almost quite still, whereas, in water agitated by bubbling air, the larva is moved horizontally.

The rami are incessantly contracted and extended. When the extension begins, they become thinner and thinner, the process starting at the base. Shortly before the greatest dilatation is attained, the now very thin rami bend outward, forming two very elegant curves. Almost at the same moment the contraction begins. During the extension of the rami the body of the larva is contracted, during the contraction extended. By means of the aquarium microscope it can now be observed that during the contraction of the arms the body is lifted a little, whereas it sinks down again during extension. Actually the motion may best be described as an uninterrupted treading water almost in the same spot, in some cases combined with a very slight, hardly detectable, ascending motion. The principle applied is that of cross-section resistance. During the extension of the very thin outward-curved arms, the falling motion is retarded, and the animal rests on the horizontally extended tip of the arms. Then, during the contraction of the arms, the body is hauled upwards. On the other hand, when they are contracted and the horizontal parts drawn in, no part of the body counteracts the fall and so it must sink. As is well known, very many plancton organisms in fresh water make use of the cross-section resistance so as to remain suspended in the water layers, but in all cases merely by means of stiff chitinous thorns, surfaces, etc. All these organs are only able to counteract the fall, not to prevent it entirely; locomotoric organs are always required to prevent the fall. In *Bucephalus* we have an organism which, by means of contraction and extention of the organ intended to counteract the falling motion, is able to remain suspended almost in the same spot of the water layers. All other furcocercous Cercariae have a powerful swimming organ in the unpaired part of their tail, and in the rami which are held horizontally an organ to prevent the fall and keep the body suspended when the motion of the tail ceases. During the pause of immobility the Furcocercaria sinks very slowly; then the motion of the tail stem sets in again, and the larva assumes its old place. However, *Bucephalus* has practically nothing left of the unpaired part of the tail stem; only the two long rami remain. Active motion in a horizontal direction is impossible to it, but by the contraction and extention of the rami, owing to which there is a rhythmic alternation in the cross-section resistance, it is able, during life, to carry out an uninterrupted leaping motion on the spot.

The encystation chiefly takes place in *Cyprinidae,* according to Wunder (1924 a, p. 319) especially in *Scardinius erythrophthalmus.* The rudimentary tail "die beiden Wülste: die beiden Scheiben" (Ziegler 1883, p. 27) secretes a viscous matter by which the Cercaria is fastened to the body of the fish, or drawn into the mouth when the fish snaps at it. The Cysts have been described by Wunder (1924 a, p. 320). Wunder says (1924 a, p. 323) that the Cercariae ascend to the surface and "mit ausgebreiteten Schwänzen hängen sie so in ungeheurer Menge stundenlang". This I have never observed. On the other hand, I have seen them, after living pelagically for 24 hours, sink to the bottom, where they assumed the position shown in fig. 1. They adhere to the bottom by means of the rudimentary tail.

The Cysticercaria group.

Cercaria splendens Szidat.

Pl. XIX, figs. 1—3.

In July 1910, when fishing with a closing-net at a depth of 4—10 m. over the shell deposits of Furesø, I found in the sample two very remarkable organisms belonging to the same species. They were pear-shaped hyaline organisms, provided posteriorly with a peculiar broad brown flattened band and ending in two broad plates. In the hyaline pear-shaped part there was a Trematode with two suckers. The samples were taken to my laboratory in the live state, and the organisms were found there. They stood suspended in the water, but now and then they suddenly jumped, moving the tail from one side to the other, while simultaneously the broad plates were clasped together and then again opened. The acute end of the pear-shaped part was turned upwards. A rough sketch was made, but being occupied with other kinds of work, I did not complete the investigation.

In 1913 when gathering the material for my Furesø studies (1917) one specimen of *Limnaea auricularia* threw out many specimens of the same form. Occupied with investigations remote from Trematoda I did not study them more thoroughly. Only some slides were taken.

In 1932 and 1933, while I was studying the Cercaria fauna of our freshwaters, many hundred *L. auricularia, L. stagnalis, Bithynia,* and *Planorbis* species from the Furesø were brought into my laboratory in spring, summer, and autumn, and several hundreds were dissected. Curiously enough, I never met with one of these Cercariae again. I am thus compelled to give very insufficient drawings from my slides of this highly remarkable organism. In 1932 I received Szidat's excellent paper on "Ueber cysticerke Riesencercarien" *C. mirabilis* M. Braun and *C. splendens* Szidat (1932a, p. 477). However, casual my drawings were, there could be no doubt that it was *C. splendens* which I had found in 1910 and 1913. Szidat points out that only seven species of true Cysticercariae are known, five of which are found in North America. These are *C. Wrightii* Ward 1885, *C. anchoroides* Ward 1893, *C. Brookoveri* Faust 1912, *C. macrostoma* 1917, and *C. fusca* Pratt 1919. With regard to these forms I refer the reader to Szidat's papers. Only two species are recorded from Europe, the very peculiar *C. mirabilis* Braun 1891, the giant among Cercariae, which measures 7 mm., and the new species *C. splendens* Szidat. *C. mirabilis* was not found again until Szidat found it in *Limnaea palustris* var. *corvus,* in the Rossitter Lehmstolle, Kurische Neerung, in 1930. *C. splendens* was found in *Planorbis umbilicatus.* Szidat shows experimentally that *C. mirabilis* belongs to *Azygia lucii* common in *Esox lucius.* The further development of *C. splendens* is still unknown, but later on Szidat hopes to clear up the development of this species too.

Referring the reader to Szidat's paper, and using his observations I complete my drawings by the following description.

The dimensions are:

Length of house	760
Breadth of house	500
Length of tail	770
Breadth of tail	100
Length of rami	450
Breadth of rami	480

The body is divided into three parts: a pear-shaped hyaline part containing the Cercaria; the tail stem; and the furca. The pear-shaped part is extremely hyaline, of a faint bluish tinge. According to Szidat it consists interiorly of a parenchyma with very wide meshes. At the apex is the opening into the space in which the Distomum lies. According to Szidat (1932a, p. 493) "enthält die Spitze um den Kanal der ursprünglichen Öffnung verteilt, zahlreiche feine Stränge oder Fasern, die einem unmittelbar über der Spitze der Kammer gelegenen ganglionähnlichen Körper entsprungen und von hier bis zur Oberfläche ziehen wo sie in winzigen Knöpfchen endigen". Szidat assumes that these are sensitive organs. At the sides of the chamber are further distributed peculiar sharply defined buds or knobs of somewhat different size and arranged in 6 to 7 circles. Their function is doubtful, but it seems probable that in this case too, we have to do with sensitive organs. The tail stem is very peculiar, band-shaped, equally broad at both ends, of a brown colour, and containing very powerful muscles. It is always held in a greatly curved position and it seems as if it cannot be held in a straight position. Szidat says quite correctly: "In der Bewegung schlägt er vielmehr ähnlich wie eine Stahlfeder heftig über die gestreckte Stellung hinweg, um dann in gleicher Form aus der rechts in die links gerichtete Krümmung überzugehen" (1932a, p. 494). The two rami are extremely broad, almost circular; they are much more hyaline than the tail. At this point I find the only difference between Szidat's specimens and mine. Szidat says that the borders of the rami are furnished with a series of very fine spines; here my specimens have a number of papillae, and these papillae are dispersed over the whole surface. Further, the rami have a very conspicuous longitudinal and transversal system of fine muscle threads crossing each other at right angles. The excretory canal runs through the tail. It is rather inconspicuous here. On entering the rami, it divides, and now the two branches are very conspicuous, ending in an opening on a small tip in the middle of the ramus. The distomulum itself is of a yellow colour. A more detailed description is still a desideratum. Szidat merely says about it that it "abgesehen von der geringeren Grösse sich kaum von der junge Wurm vom dem der *C. mirabilis* unterscheidet".

With regard to the Redia I refer the reader to Szidat's observations. It resembles a Sporocyst, but there is a very small pharynx which, according to Szidat, is also used as a genital opening. A gut is absent; the germinal layer lies in the posterior part of the Redia. There is a conspicuous excretory organ. In their first developmental stages the Cercariae are very similar to those of the *Holostomidae* and the *Schistosomatidae*. The Cercariae leave the Redia before maturity and now draw their nourishment directly from the snail. The chamber in which the Cercaria lives in the free-swimming stage is not developed until it has left the snail; in contact with the water the cuticula and the parenchymatous tissues swell. The Cercariae mostly leave the snail between 10 and 12 o'clock. A snail gives off only 6—8 Cercariae a day: *Planorbis umbilicatus* 6, *Limnaea palustris* 3 (1932a, p. 489).

Szidat points out that these organisms are true Furcocercariae and supposes that they belong to a new species of the genus *Azygia*. It seems possible,then, that the *Azygiidae* belong to the large order *Strigeatoidea* La Rue, to which the *Strigeata*, the *Schistosomata*, and the *Bucephalata* belong. This view would seem to be corroborated by A. Lutz (1931, p. 343), who shows that the Cercaria of *Hemistomum* forms a connecting link with the "Riesencercarien" mentioned here.

The Proalaria and Strigea group.

Cercaria longiremis nov. sp. Host: *Valvata piscinalis.*

Pl. XXII, figs. 1—3.

Fully extended the body and tail are almost of the same length, and the furca only a little shorter than the stem. The dimensions are:

Cercariae.

	Living	Preserved
Length of body	245	170—256
Breadth of body	115	53—74
Length of tail	255	236—273
Breadth of tail	45	21—33
Length of furca	310	218—288
Breadth of furca	20	..
Length of anterior organ	50	22—46
Breadth of anterior organ	35	19—24
Ventral sucker	35	22—40

The anterior organ is pyriform. The forepart of the body is covered with fine spines, but there are no specially developed spines on its top. Spines on the other part of the body are only feebly developed. The anterior organ is not distinctly divided into a thin-walled anterior and a posterior muscular part. No head gland has been observed. — The small ventral sucker is situated behind the middle line of the body and its circular edges are furnished with two rows of small spines. No eyes. The opening of the alimentary canal is terminal. There is a faintly developed pharynx and a long oesophagus which bifurcates a little before the ventral sucker; the intestinal coeca are broad; they reach only half-way between the ventral sucker and the bladder. In the posterior part they give the impression of being divided by transversal folds. There are eight penetration glands, lying behind the ventral sucker; they contain a granular cytoplasm and vesicular nuclei; they give off the ducts which above the bifurcation of the oesophagus curve into the middle of the body, whereupon they again curve outwards and enter the anterior organ sideways near its posterior end. The bladder lies immediately anterior to the junction of the tail; it consists of a smaller posterior part which is provided with two broad horns from which the two main lateral collecting tubes issue. I have been unable to see any transversal commissure. Near the middle of the ventral sucker is a tangled mass of the main collecting tubes, and from here arise anterior and posterior collecting tubes. I have observed 5 flame cells on each side, two near the anterior organ, two near the tangled mass, and one behind this at the beginning of the tail. I suppose that the number here has been greater. An inlet of Cort has not been observed; the posterior tube passes through the whole length of the tail and divides to enter the furca, but I have not seen if they reach the tips. — The powerful tail is attached to the posterior end of the body; the union seems very strong since decaudation only rarely takes place. It has a layer of circular and longitudinal muscles. The most peculiar feature, however, is two series of caudal bodies ending in one to three protuberances fastening themselves on the sides of the tail-stem. There are no finfolds, and the rami of the furca are narrow.

The Cercaria is a typical plancton organism, especially in deep water in large lakes. It stands suspended in the water with the body downwards and the long rami stretched out on a line perpendicular to the long axis of the body. It seems not to have any special predilection for light. For further particulars, I refer to Chapter VIII relating to the biology of the Furcocercariae. — The host is *Valvata piscinalis* whose liver and interior organs may all be covered over by tangled interwoven masses of thin-walled Sporocysts. It is almost impossible to dissect them entire, but pieces of a length of 7—8 mm. are not rare. — They have often a knotted appearance and in the widened parts the Cercariae are developed. A birth pore has not been observed.

The species has only been found in *Valvata piscinalis* from Tjustrup Lake. On 25/VII 1931, 30 were found at a depth of 2 m. On 28/VII, 80 were found at 5—10 m. Of the 30 from 2 m. only one was infected, of the 80 from 5—10 m, 12 were infected.

As no Furcocercaria has been found in a *Valvata* at all events in Europe, and my form presents several peculiarities of structure such as the course of the ducts from the penetration glands, the peculiarly formed bodies in the tail, and its remarkably large size, it seems necessary to regard it as a new form.

Cercaria C. Szidat. Host: *Limnaea stagnalis, L. auricularia.*

Pl. XXII, figs. 4—5. Pl. XXIII, fig. 1. Microphoto Pl. XXVI, fig. 2.

Fully extended the tail is longer than the body; the breadth may be almost the same; the furca a little shorter. The dimensions are:

Cercariae.

	Living	Preserved
Length of body	265	173—197
Breadth of body	85	56—65
Length of tail	240	215—222
Breadth of tail	40	23—47
Length of furca	220	195—212
Length of anterior organ	55	35—45
Breadth of anterior organ	35	23—29
Ventral sucker	35	22—39
Mother sporocyst	14300	..

The forepart of the body is covered with fine spines; its tip is protrusile; it carries no thick spines. The anterior organ is large, pyriform, almost twice as long as broad. It is not divided in a thin walled anterior and a posterior muscular part.

Head glands have not been observed. The ventral sucker lies behind the middle line of the body and is furnished with two rows of small spines. No eyes. There is a small prepharynx and an almost globular muscular pharynx. The oesophagus bifurcates immediately before the ventral sucker. The intestinal coeca reach the bladder and diverge a little at their posterior end. There are four penetration glands lying behind the ventral sucker; the two anterior lying above each other, the two posterior ones beside each other. The cytoplasm is granular and the vesicular nuclei are very conspicuous. The course of the ducts is slightly sinuous and they enter the anterior organ near the posterior end. The bladder lies just anterior to the junction of the tail; it is globular or rectangular; it gives off two main lateral collecting tubes and one posterior tube which drains the tail. Near the middle of the ventral sucker is a tangled mass from which an anterior and a posterior collecting tube are given off. A transversal commissure is visible immediately before the ventral sucker. On each side are observed 5 vibratile tags, and one pair at the base of the tail. Perhaps a sixth pair at the posterior corners of the body has been overlooked. An inlet of Cort has not been observed. The posterior tube passes through the whole length of the tail and divides to enter the furca, it opens on the interior side of the rami, mid-way. The tail possesses one layer of circular and one of longitudinal muscles. There are many caudal bodies arranged serially or in small lumps. There are no finfolds on the furca.

With regard to its biology I refer the reader to chapter VIII. The host is *Limnaea stagnalis* whose liver and interior organs may all be covered by tangled interwoven masses of very long and very thin Sporocysts. They are provided with a subterminal birth pore through which, on 4/XII 1932, I saw Cercariae come out. These Sporocysts have almost straight sides and no alternation of narrower and broader parts. When dissecting a *Limnaea* from Bagsværd Lake whose liver was covered by interwoven Sporocysts, it suddenly gave off a 2 cm. long Sporocyst which, so to speak, shot out of the liver. It was almost 1 mm. thick and had a peculiar proboscis at one end (Pl. XXII, fig. 5). The skin was remarkably thick and showed, especially in the forepart, rings which I suppose to be of muscular consistence. The Sporocyst was opaque and the skin of a peculiar, almost leathery appearance. It contained not a single Cercaria but 5 small daughter Sporocysts packed with small grains. Otherwise the whole interior was empty. A birth-pore could not be observed but when pressed the daughter Sporocysts came out at different points of the skin. All other Sporocysts contained only Cercariae. There can be no doubt that the large Sporocyst was the mother Sporocyst or one of them. Only the proboscidal prolongation showed a slight power of motion; otherwise it was quite motionless. It seems as if these mother sporocysts have no power of division and are only able to produce daughter sporocysts, not Cercariae. It was found at a time when its power of production was almost exhausted. The snail contained only this single mother Sporocyst. As far as I know, these mother sporocysts are only rarely observed.

This species was found in *L. stagnalis* from Bagsværd Lake on 25/VII 1931, but only in one specimen out of 8; in Furesø on 30/IX 1932 in one very large specimen of *L. stagnalis;* and in *L. auricularia* in 7 out of 70 specimens. On 17/XI it was found in 20 out of 70.

I have determined this species as *Cercaria C. Szidat*; it is nearly related to *C. furcata* Nitsch, *C. fissicauda* la Val., and *C. helvetica XIII* Dubois. They are all found in *L. stagnalis;* at all events they may belong to the same group. This is also the case with *C. flexicauda, laruei* and *modicella*, all described by Cort and Brooks (1928, p. 183). Taylor and Baylis (1930, p. 232) and Gwendolen (1932, p. 25) suppose that the Cercaria *x* of Taylor and Baylis is identical with *C. helvetica XIII* Dubois. Furthermore it may be nearly related to *C. chromatophora* Brown found in *Limnaea stagnalis* (1931, p. 95). *C. chromatophora* has small areas of pale yellow pigment granules spread over the body and tail. All these species seem to belong to the same group. With regard to their biology I refer the reader to Chap. VIII.

Cercaria strigeae tardae Mathias. Host: *Limnaea stagnalis.*

Pl. XXII, fig. 6. Pl. XXIII, fig. 3. Microphoto Pl. XXXVII, figs. 9—12.

Fully extended the tail is shorter than the body, the furca almost of the same length as the tail. The dimensions are:

Cercariae.

	Living	Preserved
Length of body	370	152—203
Breadth of body	95	62—85
Length of tail	280	170—209
Breadth of tail	45	35—45
Length of furca	285	173—233
Length of anterior organ	75	45—48
Breadth of anterior organ	35	25—33
Ventral sucker	50	22—31

The whole body is covered with fine spines most prominent in the forepart, which has a protrusile part, densely covered with spines. The anterior organ is of an oblong pyriform shape; as the figure shows, it may be almost twice as long as broad but may also be contracted so much that it is almost isodiametric. There is no division into an anterior thin-walled, and a posterior muscular part, but the whole organ has an abundant equipment of muscle threads. No head glands have been observed. The ventral sucker lies in the posterior part of the body, rather distant from the middle line. It is furnished with a single row of short spines. There is a conspicuous prepharynx, a pharynx and a short oesophagus which divides, not near the ventral sucker, but almost in the middle line between it and the anterior organ. The intestinal coeca are broad and, in all the specimens I have seen, have a peculiar sinuous course. The posterior end almost reaches the bladder. There are four penetration glands lying before and laterally to the ventral sucker; the cytoplasm is granular, and the vesicular nuclei very conspicuous. At the pharynx the ducts bend first outwards and then again inwards, and enter the anterior organ at its base. The bladder is small and often shows anteriorly two horns from which the two main collecting tubes issue. A little above the ventral sucker the tubes form a tangled mass and above it lie two very conspicuous glomeruli connected with each other by a transversal commissure; an anterior and a posterior collecting tube issue from here; the anterior possesses two flame cells, the posterior three lying where they are drawn in the figure. From the posterior part of the bladder issues a tube running through the whole tail and sending a branch into each of the rami of the furca. These branches open on the inner side of the rami a little beneath the middle line. The tube has two pairs of flame cells near the base of the tail. The tail is almost as broad as the fully extended body. It has a layer of circular and longitudinal muscles. A series of small caudal bodies are arranged along the excretory tube. There are no finfolds.

The host is *Limnaea stagnalis*. The Sporocyst is long and filiform, it often attains 10—15 mm. and may reach 2 cm. or even more; the Sporocysts are mainly found in the liver but when the infection is extensive, all organs may be covered over; specimens may be found whose interior seems to consist almost entirely of Sporocysts. The brown colour of the liver is altered into a yellowish white. When immersed in a $3^1/_2$ $^0/_0$ NaCl solution, they move about briskly, especially the young ones. As Mathias has observed (1925, p. 48), they, as well as many other Sporocysts, propagate by division, and I suppose that this is the case with all Furcocercaria-sporocysts. Mathias (1925, p. 48) saw flame cells in the Sporocyst, not observed by others, as far as I know.

I have referred my species to *Cercaria strigeae tardae*, with which it agrees on all essential points. It differs from it, however, by the sinuous course of the intestinal coeca, and by the presence of glomeruli. The future must decide whether these differences are sufficient to create a new species. *Cercaria strigeae tardae* has been found in *Limnaea stagnalis* from Strødam and studied there in very many specimens from almost all seasons of the year. Either as a Cercaria or as a Tetracotyle it is present the whole year round, as Cercaria only in the summer months; of 127 *Limnaea stagnalis* 103 were infected.

At Donse it has further been found on 7/VII and 10/XI 1932 in 30 and in 8 specimens of *L. stagnalis*, i. e. in all 38 specimens examined. In most of them they were present as Tetracotyle. As a Tetracotyle the species is present in almost all our mollusk species but as a Cercaria I have hitherto only found it in *L. stagnalis*. Mathias (1925, p. 61) has shown that it is possible to find in nature or to infect experimentally *Limnaea stagnalis, ovata, palustris, auricularia; Planorbis corneus, P. umbilicatus,* and *Bithynia tentaculata*; and supposes that if *L. ovata* is only rarely infected, this is due to the fact that *L. stagnalis* is more restricted to the surface than *L. ovata* which is mainly limited to the bottom. The Cercariae seek the surface and will therefore more often infect *L. stagnalis* than *ovata*. With regard to the biology I refer the reader to Chapter VIII. It may be nearly related to if not identical with *C. fissicauda* La Val. 1855 redescribed by Brown (1926, p. 30) and found by him too in *Limnaea stagnalis*.

Cercaria F. I. Harper. Host: *Planorbis umbilicatus.*

Pl. XXIII, fig. 2.

Fully extended the tail is a little shorter than the body and not so broad; the furca is of the same length as the tail, perhaps a little longer. The dimensions are:

Cercariae.

	Living
Length of body	215
Breadth of body	95
Length of tail	195
Breadth of tail	40
Length of furca	230
Breadth of furca	40
Length of anterior organ	45
Breadth of anterior organ	40
Ventral sucker	35

The body is covered with minute spines, most densely in the anterior third. The anterior organ is almost globular. There is no division in an anterior thin-walled and a posterior muscular part. No head glands have been observed. The ventral sucker lies almost in the middle of the body; it is armed on its margin with an inner row of small tubercles and an outer one consisting of short bristles. There are no eyes. After a short prepharynx follows a pharynx and a short oesophagus which divides immediately before the ventral sucker. The intestinal diverticula reach only a little behind the ventral sucker and have the appearance of being divided by transversal folds. There are two pairs of penetration glands which are placed laterally and behind on either side of the ventral sucker; their cytoplasm is granular, and the large vesicular nuclei are situated in the posterior parts of the cells. The ducts show an incurvation at the level of the pharynx, and enter the anterior organ posteriorly. The rectangular bladder gives off anteriorly two collecting tubes and one posteriorly. The two firstnamed divide at the end of the intestinal diverticula, giving off an anterior and a posterior branch. I have only been able to find five flame cells on each side; three belonging to the anterior branch, and two to the posterior one. The branch in the tail carries two pairs of flame cells; it sends a ramus into each of the furcae, where the rami open on the inner side behind the middle line. The tail has a layer of circular and longitudinal muscles. Along the posterior excretory tube lie 2 × 6 oblong flattened bodies. There are no finfolds on the furca. —

This Cercaria is found in *Pl. umbilicatus.*

The Sporocyst, when mature, projects from the surface of the liver and shows conspicuous movements. It is 4—5 mm. long. A birth pore has not been observed. —

I have only found this species once (2/V 1932) in *Planorbis umbilicatus* in a little moor on the borders of the Furesø near Frederiksdal. Of 40 specimens 8 were infected. —

It is only with some doubt that I refer this species to the *Cercaria F. I* of Harper. Mathias (1925, p. 61) infected *P. umbilicatus* experimentally with *C. strigeae tardae* from which this species differs in size, in the form of the anterior organ, the place of the ventral sucker, the structure of the alimentary canal, and by the absence of a transversal commissure and glomeruli.

It agrees in many essential particulars with Harper's *Cercaria F. I.* The main difference is that I have seen two pairs of flame cells in the tail, and that Harper found his species in *Planorbis crista* and *albus,* I mine in *Planorbis umbilicatus.* Experimentally Harper has shown that his *Cercaria F. I.* passes through a *Tetracotyle*-stage in which he refers it to *T. typica* Dies.

It may perhaps be related to *C. micromorpha* Brown (1926, p. 32) with which it has the number and position of penetration glands in common, but from which it differs by lacking the oesophagus and intestinal coeca (?) and with regard to the flame cells.

Cercaria Frederiksborgensis n. sp. Host: *Planorbis corneus.*

Pl. XXII, Figs. 7—8.

Fully extended the body, tail, and furca are almost equal in length; the body perhaps being the longest. The forepart of the body is covered with short spines; the spinosity of the posterior part is but slight. The dimensions are:

Cercariae.

	Living
Length of body	230
Breadth of body	110
Length of tail	180
Breadth of tail	45
Length of furca	220
Length of anterior organ	50
Breadth of anterior organ	45
Ventral sucker	40

Sporocysts.

Length	180

The anterior organ is almost globular. No division into an anterior thin-walled and a posterior muscular part. No head glands have been observed. The ventral sucker lies in the posterior part of the body, the anterior edge almost in the middle line; it is a little smaller than the anterior organ. It is furnished with two rows of short spines. There are no eyes. After a pharynx follows a long oesophagus which divides immediately before the ventral sucker. The intestinal coeca, which have straight contours, reach the bladder. There are six penetration glands placed behind the oral sucker; their cytoplasm is granular; the vesicular nuclei are very conspicuous. The ducts have a sinuous course and enter the anterior organ laterally. The bladder is small, globular or rectangular. The two anterior main collecting tubes divide near the anterior edge of the ventral sucker into an anterior and posterior branch, each of which carries three flame cells. Posteriorly the bladder gives off a tube which passes through the whole tail and bifurcates near the rami. They open on the inner side a little below the middle line. The tail has one layer of circular and one of longitudinal muscles. There are two series of low caudal bodies, of which the first is remarkably large. I have been unable to detect any flame cells in the tail, but suppose that I have overlooked them. There are no finfolds.

The host is *Planorbis corneus;* the Sporocyst is long, filiform, packed either with small germ balls often arranged in two series or with a crowd of Cercariae which move slowly up and down. A birth pore has not been observed. The species was found in one of 45 specimens from Torkeris Pond on 26/IV 1932. The Sporocysts which were in lively motion were mainly found on the intestine, not so much in the liver. The snail had not shown Cercariae; they were not found until the snail was opened; perhaps the Cercariae were not quite ripe. On 29/VI 1932 20 *Planorbis corneus* were opened but none was infected by Furcocercariae.

Cercaria linearis n. sp. Host: *Planorbis corneus.*

Pl. XXVI, figs. 1—2. Microphoto Pl. XXXVI, fig. 6.

Fully extended the tail is shorter than the body and the furca almost as long as the body. The dimensions are:

Cercariae.

	Living
Length of body	250
Breadth of body	50
Length of tail	170
Breadth of tail	40
Length of furca	210
Length of anterior organ	40
Breadth of anterior organ	25
Ventral sucker	45

The forepart of the body is spinose, the posterior part only in slight degree. The anterior organ is of a relatively small size, pyriform when the body is extended, and almost globular when it is strongly contracted. There is no division into an anterior thin-walled and a posterior muscular part. No head glands have been observed. The ventral sucker is placed almost centrally a little behind the middle line. It has a single row of short spines. After a well-developed pharynx follows an oesophagus which divides immediately before the ventral sucker. The intestinal branches, which have straight sides, reach halfway between the ventral sucker and the bladder. There are six penetration glands, lying before the sucker. The cytoplasm is granular, and the vesicular nuclei are conspicuous. The ducts take a somewhat sinuous course and reach the anterior organ at its posterior edge. The small bladder often shows two horns from which the two main collecting tubes issue. At the sucker they divide into an anterior and a posterior branch. On the anterior branch I have seen three vibratile tags, on the posterior, two. From the posterior part of the bladder an excretory tube passes through the whole tail, but I have not been able to see it bifurcate and pass out into the furca. There are two pairs of vibratile tags in the tail. When fully extended the tail is as broad as the body. It has a circular and a longitudinal muscle layer. Globular bodies along the excretory tube, if present, are at all events very inconspicuous.

The host is *Planorbis corneus.*

The Sporocyst is 4—6 mm. long, filiform.

The species has only been found once in Hørsholm Pond on 25/V 1932. Of 24 specimens 4 were infected. —

Only very few *Furcocercariae* have been recorded from *Planorbis corneus;* apart from *Bilharziella polonica* Cercaria B has been described by Szidat (1923, p. 303). This species is said to possess six cystogeneous cells disposed laterally to the ventral sucker (Szidat, however, draws 7). In my two species from *Planorbis corneus* the 6 cells are placed either before or behind the sucker. Mathias (1925, p. 61) has infected *Planorbis corneus* experimentally with *Cercaria strigeae tardae* with which my two species cannot be compared. — The two species described here differ in size; in the relation in size between the oral organ and the ventral sucker; in the disposition of the penetration glands before or behind the ventral sucker, and perhaps in the excretory system.

Cercaria helvetica XXXI Dubois. Host: *Limnaea palustris.*

Pl. XXVI, figs. 3—7.

Fully extended the body, tail, and furca are all of almost the same length. The dimensions are:

Cercariae.

	Living	Preserved
Length of body	180	116—122
Breadth of body	45	47—54
Length of tail	180	119—159
Breadth of tail	40	37—42
Length of furca	175	134—173
Length of anterior organ	45	29—37
Breadth of anterior organ	30	17—21
Ventral sucker	30	19—27

Sporocysts.

	Living	Preserved
The mother sporocyst	17400	..
A daughter sporocyst..................	2140	..

The forepart of the body is covered with fine spines; its tip is protrusile. The anterior organ is larger, pyriform, one and a half times as long as broad. It is not divided into a thin-walled anterior and a thicker posterior muscular part. Head glands have not been observed. The ventral sucker lies almost in the middle line. I have only been able to see two rows of small spines. There is a small prepharynx and an almost globular muscular pharynx. The short oesophagus bifurcates immediately before the ventral sucker. The intestinal diverticula do not reach the bladder, but their posterior end is not visible owing to the abundant equipment of penetration glands. Of these there are eight, commonly disposed in three rows with three cells in the first rows and two in the last all lying behind the ventrial sucker. The cytoplasm is granular, the nuclei are large. The ducts have an incurvation just above the ventral sucker. They enter the anterior organ at its posterior edge. — The bladder is broad, anteriorly giving off two collecting tubes, posteriorly one. Near the middle of the ventral sucker is a tangled mass from which an anterior and a posterior collecting tube are given off. A transversal commissure is present before the ventral sucker; another, behind the sucker, I have been unable to observe. The anterior collecting tube is provided with two flame cells, the posterior with four; in the tail one pair is observed. The collecting tube in the tail divides into two branches which pass into the furca, most probably opening halfway on the inner side of the furca. The tail has the normal layer of circular and longitudinal muscles. I have counted eight to ten large globular bodies almost filling out the whole space between the excretory canal and the muscle layer. There are no finfolds. —

The host is *Limnaea palustris.* — The liver and germ gland are packed with enormous amounts of long threadlike Sporocysts containing fully developed Cercariae. These Sporocysts break up, divide, and the parts grow up. Their length is 1—2 mm., they have a conspicuous birth-pore placed near the forepart, which is extremely mobile; the colour is white. They often show irregular broader parts separated from each other by indentations and notches of different kinds. The broader parts seem to be regular broad chambers packed with Cercariae. In the extreme posterior part is the germ chamber in which globular germs are present, and from which the germs are pushed forward into the chambers placed more anteriorly. The wall of these Sporocysts is very thin, hyaline. They produce Cercariae only. Among all these Sporocysts was found a single one not less than c. 1.4 cm. long (Pl. XXVI, fig. 5). This Sporocyst was almost equally broad throughout; it had peculiarly mottled very thick walls wrinkled on the outer side and with peculiar regular undulations on the inner side (Pl. XXVI, fig. 7). The Sporocyst was almost empty. It contained only three daughter Sporocysts packed with germ balls. The mother Sporocyst was almost motionless; only a slight movement could be observed at the apex. One of the daughter Sporocysts came out through the skin of the mother sporocyst (Pl. XXVI, fig. 6). No birth pore could be observed. There is no doubt that we have here to do with the old mother Sporocyst from which the whole infection of the snail has taken place. Most probably there are only two Sporocyst generations, the first without power of division and a second in which propagation is partly by division and partly by Cercariae. Judging by observations from other Furcocercaria-sporocysts, it seems most probable that the mother Sporocyst only produces Sporocysts, not Cercariae. In the daughter Sporocysts I have never found a new generation of Sporocysts, only Cercariae.

This species was found in the canals in the little park Indelukket near Hillerød 13/IX 1932 and in a little bay of Tjustrup Lake. Of 10 specimens of *L. palustris* only one was infected.

I have referred this species to *C. helvetica XXXI* Dubois (1929, p. 94) but it is also very nearly related to *C. burti* Miller (1923, p. 41). It differs from both in the following points. The ventral sucker is placed almost in the middle line, in the other two posteriorly. Since, however, I have seen how the two parts of the body in the Furcocercariae, that before and that behind the ventral sucker, may dilate and contract independently, I do not regard this difference as very significant. I have only seen one transversal commissure before the ventral sucker. *C. helvetica XXXI* has two, one before and one after the sucker. *C. burti* one, but behind. I fear that one of the commissures has been overlooked, and as the three species agree with regard to number and position of penetration glands, the alimentary canal, and the excretory system, I feel inclined to regard all three as identical; the host is common to *C. helvetica XXXI* and my species.

Cercaria A. Szidat. Host: *Limnaea palustris.*

Pl. XXVII, fig. 1.

Fully extended the body is longer than the tail, and tail and furca are of almost the same length. The dimensions are:

Cercariae.

	Living	Preserved
Length of body	340	146—215
Breadth of body	85	45—79
Length of tail	225	170—226
Breadth of tail	40	27—45
Length of furca	280	162—218
Length of anterior organ	65	28—48
Breadth of anterior organ	40	25—73
Ventral sucker	55	29—34

The whole body is covered with fine spines more prominent in the first-third, the tip is protrusile and covered with stouter spines and four papillae on which the two pairs of canals for the penetration glands are placed. The anterior organ is large, globular or pyriform. It is not divided into a thin-walled anterior and a posterior muscular part. Head glands have not been observed. The ventral sucker lies far behind the middle line; I have only been able to see two concentric circles of small spines. There is a short prepharynx followed by a globular pharynx. There are no eyes. The long oesophagus divides immediately before the ventral sucker into the two intestinal coeca with almost straight sides. Their posterior part reaches the bladder. There are four large penetration glands placed before the ventral sucker, the posterior two to the left and right side of the middle line; the anterior two are more dorsally and ventrally disposed in relation to the two first-named. They are large and have a granular cytoplasm and large vesicular nuclei. The ducts run almost straight forward to the posterior part of the anterior organ through which they pass. They debouch in four small retractile papillae. The bladder is globular or rectangular. There are two anterior excretory ducts and one posterior. Near the anterior edge of the ventral sucker the two anterior ones form a tangled mass from which an anterior and a posterior collecting tube issue. A transversal commissure is present before the ventral sucker. Of vibratile tags I have only observed three pairs in the forepart of the body, and two in the posterior part. In the tail two pairs. The posterior tube passes through the whole length of the tail and bifurcates before the furca. The opening of the two branches I have not seen with certainty. The tail possesses a layer of circular and longitudinal muscles. Caudal bodies have not been observed; there seems to be a layer round the posterior tube connected by threads with the muscle layers and containing scattered nuclei.

The host is *Limnaea palustris.*

The filiform-whitish, very mobile, Sporocysts attain a length of almost one cm.

The species was found on 25/V 1932, Furesø. Of 25 specimens of the snail, 7 were infected. All the 25 specimens simultaneously contained Tetracotyle.

I refer this species to *Cercaria A.* Szidat (1923, p. 301) found by him in *Limnaea palustris* and by Dubois (1929, p. 88) in *Limnaea stagnalis.* Dubois found 20 vibratile tags, I have only seen 12. Some pairs have probably been overlooked by me.

Cercaria letifera Fuhrmann. Host: *L. auricularia.*

Pl. XXVII, figs. 2–8.

Fully extended the tail is shorter than the body but the furca almost as long as the body. The dimensions are:

Cercariae.	Living	Preserved
Length of body	280	188—232
Breadth of body	45	51—54
Length of tail	195	144—167

	Living	Preserved
Breadth of tail	40	29—33
Length of furca	225	146—186
Length of anterior organ	50	44—45
Breadth of anterior organ	35	31—36
Ventral sucker	30	39—46

Sporocysts.

Mother sporocyst	11800	..
Sporocyst	2840	..
Sporocyst	3520	..

The forepart of the body is covered with spines arranged in rows; the apex of the body without thorns; above the mouth opening a series of stouter spines; the anterior organ is oblong or pyriform. It is not distinctly divided into a thin-walled anterior and a posterior muscular part but many transversal muscles cross the posterior part. Head glands have not been observed. There are no eyes. The ventral sucker lies behind the middle line and is remarkably small. It is furnished with a row of short curved spines. The pharynx is globular and the oesophagus bifurcates, not near the ventral sucker, but almost in the middle line between it and the oral organ. The intestinal coeca, which are broader in the posterior part, do not reach the bladder but stop a little past halfway between it and the ventral sucker. There are four penetration glands, placed before the ventral sucker, the posterior two lie on both sides of the middle line, the anterior two one before the other. The cytoplasm is granular, the nuclei large and vesicular. The ducts diverge before the pharynx, and enter the anterior organ at its posterior edge. The small bladder shows two horns to which the two anterior excretory vesicles run. Near the anterior contour of the ventral sucker they divide into an anterior and a posterior branch. The first carries 4 flame cells the last-named 2. The posterior tube running through the tail bifurcates near the furca and opens in the middle line on the interior edge of the rami; there are no finfolds. There are 5 pairs of globular bodies of irregular form and with conspicuous nuclei. The host is *Limnaea auricularia*.

The Sporocysts are threadlike thin-walled hyaline sacks with great power of locomotion. Among those reaching 0.5—0.7 mm., a single one attained more than 1 cm. Most probably it was the mother-sporocyst (Pl. XXVII, fig. 3). As the figures (figs. 4—8) show, the other may be extremely irregular, with broad parts followed by very narrow ones. These last-named are of a greyish colour and look as if they had no lumen. The brood, the Furcocercariae, lie in the broad parts. Some of them at one end show something like a sucker (fig. 8), a broad flat plate furnished with a stalk after which follows one of the brood chambers. The anterior part has often a proboscidal prolongation with a great power of locomotion. In one of the specimens I saw the very conspicuous birth pore through which at the very same moment a Cercaria passed out (fig. 4). The birth pore had dentated edges. — The species has been found in a single very large specimen of *L. auricularia* gathered at the outflow of Susaa into Tjustrup Lake (30/V 1931). I refer this species to *Cercaria letifera* Fuhrmann (1916, p. 389) with which it has all the essential anatomical details in common. According to Fuhrmann and Dubois the coeca "divergent a deux niveaux". This is also the case when the body is contracted; it is, however, not specific for this species but common to all Furcocercaria where the coeca diverge midway between the anterior organ and the sucker. — Dubois (1929, p. 81, Tab. V, fig. 19) found 4 flame cells in the middle of the tail. These cells I have been unable to see.

Cercaria I Petersen. Host: *Physa fontinalis, Limnæa ovata, L. auricularia.*

Pl. XXVIII, figs. 1—4.

Fully extended the tail is shorter than the body, but the furca almost as long. The dimensions are:

Cercariae.

	Living
Length of body	200
Breadth of body	45
Length of tail	160
Breadth of tail	40
Length of furca	180
Length of anterior organ	50
Breadth of anterior organ	30
Ventral sucker	35

The forepart of the body is strongly spinose; the spinosity of the rest of the body is but slight. The anterior organ is pyriform, remarkably thick behind, often almost globular. It is not conspicuously divided into a thin-walled anterior and a posterior muscular part, but many transversal muscles cross the posterior part. No head glands have been observed. The ventral sucker lies almost in the middle line of the body, perhaps a little behind it. It is smaller than the anterior organ. It has two concentric circles of small curved spines. The pharynx is globular, the oesophagus is long and divides immediately before the ventral sucker. The diverticula are a little broader in the posterior part; they almost reach the bladder. There are six penetration glands placed two and two behind the ventral sucker, in three series one behind the other. The contents are granular and the vesicular nuclei conspicuous. The ducts take a rather straight course and reach the anterior organ at its posterior border. The bladder is rectangular. To the anterior corners run two excretory vessels, and one posterior through the tail. On reaching the ventral sucker, the vessels form a tangled mass which in specimens from *Physa* form a real glomerulus (Pl. XXVIII, fig. 2); here it divides into an anterior and a posterior branch; the anterior carries at least three flame cells, the posterior three or four. The caudal excretory vessel runs through the whole stem and divides before the furca, but I have been unable to see the course in the rami with certainty. 2 × 2 vibratile tags were found in the tail. The posterior branch in the body forms, especially when a little contracted, a peculiar outward curvation. A commissure posterior to the ventral sucker is most probably always present; at all events it is very conspicuous in specimens from *Limnaea ovata* (Pl. XXVIII, fig. 1). The tail has a layer of circular and one of longitudinal muscles. Along the excretory vessel there commonly lie 2 × 9 caudal bodies; but in some cases the two series are disposed in a single row; the caudal body is then very large, as large as two of the caudal bodies lying before it (Pl. XXVIII, fig. 1). The large nucleus lies immediately above the excretory vessel. There are no finfolds.

The hosts are: *Limnaea ovata, L. auricularia,* and *Physa fontinalis.*

The Sporocyst is long, threadlike, greyish in colour; the length is 6—8 mm. and may reach 1 cm. or a little more. It is very mobile; the older ones are very irregular, with inflated parts followed by narrower ones. The brood lies in the former parts. —

I have referred a cercaria which has been found in several localities in different snails to *Furcocercaria I.* Petersen (1931, p. 14). It is a Cercaria with 6 penetration glands behind the sucker. I have not seen the cells mentioned by Petersen as "ein quergelagerter Zellhaufen ohne Ausführgänge vor dem Bauchsaugnapf". As far as I know, this is a unique structure among Furcocercariae.

The vivax group.

Cercaria vivax Sonsino. Host: *Bithynia tentaculata.*

Pl. XXIX, fig. 1.

The dimensions are:

Cercariae.	Living
Length of body	260
Breadth of body	145
Length of tail	230
Breadth of tail	50
Length of furca	220
Length of anterior organ	45
Breadth of anterior organ	45

Fully extended the body and tail are almost of the same length, the furca is shorter. In its broadest part the body is almost three times as broad as the tail. As in all hitherto known members of the *vivax* group the body is broad; it is incapable of being contracted to the breadth of the tail and remarkably flattened. The tail is attached ventrally. The whole surface of body and tail, as far as I have been able to see, is devoid of spines. — Loos (1900, p. 218) says that "la peau est ornée de piquants extrêmement delicats". The anterior organ is rounded, pyriform, very protrusile and on its surface provided with circular rows of spines. It is no sucker, but a real penetrating organ. One pair of head glands lie immediately behind the organ, but I have been unable to see openings of any kind. The ventral sucker is absent, but in its place is found a circular group of parenchymatous cells. It has been overlooked by Sonsino, but has been seen and figured by Loos (1900, p. 219) who describes it as a ventral sucker. There is a globular pharynx, and a short oesophagus bifurcating in the first third of the body into the two intestinal coeca which with their white, clear, almost silvery aspect characterise all members of the group at the first glance. They reach the bladder, their contours show slight sinuosities, but no sharp indentations. As in all members of the group, there is no trace of penetration glands. The excretory system is highly characteristic. The bladder is broad and may be trilobate. I have not observed the excretory pore mentioned by Sewell (1922, p. 282) for *Cercaria Indicae XV*. From the anterior border of the bladder there issue four excretory canals; the two median ones pass forward into the space between the intestinal coeca. Below the place of the ventral sucker they unite, and near the point where the intestinal coeca arise they divide again, giving off two branches issuing almost perpendicularly and uniting with the two outer canals which run outside the intestinal coeca. Where the transversal canal unites with the outer longitudinal canal, a branch runs anteriorly to the anterior organ. From the posterior border of the bladder there issues a caudal excretory vessel which before the furca divides into two branches running through the rami and opening on their tip. The number of vibratile tags in the body is large, most probably 2×10 or 2×12. I have been unable to see the connecting excretory capillaries. In the tail there are three pairs lying near the base. The tail has an outer circular, and an inner longitudinal row of muscle fibres, which run obliquely from the cuticula to the inconspicuous parenchymatous cells surrounding the excretory vessel. The flattened rami are provided with a finfold. — The host is *Bithynia tentaculata*.

C. vivax develops in Sporocysts of a length of 3—4 mm.; a birth pore is present, and this, as far as I have been able to see, is terminal. Loos (1920, p. 213) states that it is subterminal. I have never seen the Sporocysts with the strong and regular constrictions mentioned by Loos and figured by Langeron (1906, p. 26). They often show conspicuous constrictions, between which the brood chambers lie; most probably the Sporocysts propagate by division. I have not seen the excretory system observed and mentioned by Loos. Loos has furthermore shown that the Sporocysts contain in their body cavity "des germigènes libres" and after reading this, I feel convinced that his observations on this point are quite correct, and that what I originally supposed to be free-lying germ balls were in reality "des germigènes libres" surrounded by a cellular envelope. They lie among the germs. The number of germs may be very large, but in older Sporocysts which contain Cercariae their number is only rarely above 50. In this species mother sporocysts have not been found.

I have seen this species only once in *Bithynia tentaculata* from the moor of Vixö (17/VII 1931). Of 40 specimens it was present in 3. —

I refer this species to the *C. vivax* of Sonsino which it resembles on all essential points. It has been re-described by Loos (1900, p. 210).

In spite of a very insufficient drawing, it would seem reasonable to suppose that it is a form of the *vivax* group which Wunder (1924 a, p. 313) has drawn, and in which he studied the tail and its motion. His contention that two excretory canals run through the whole tail cannot be correct. Sewell (1922, p. 285) has made a highly interesting observation with regard to the Sporocysts of *C. indicae XV*. He maintains that the Sporocysts are able to produce Miracidia, and describes and figures these Miracidia, comparing them to those of *Schistosomum haematobium*. I agree with Langeron (1924, p. 28) who asks whether the observer "a senti toute l'importance d'une assertion qui renverse toutes nos connaissances sur la biologie et l'évolution des trematodes". I regret very much that I did not seize the opportunity, when it presented itself, to corroborate or invalidate Sewell's observation. Curiously enough, I have actually found numerous small cilia-covered organisms swimming among the germ-balls in the Sporocysts of *C. vivax*. Several times I have found Infusoria in the body fluids of snails, but being then unacquainted with Sewell's observations, I paid no special attention to them. I regarded them as Infusoria, and to this very day I do not think it possible that they can have been anything else. On the other hand, it is a curious thing that these organisms should be found precisely in the Sporocysts of a member of the *vivax* group. Later on I have of course tried to find these forms again, but without success.

Cercaria sp. Host: *Bithynia tentaculata.*

Pl. XXIX, fig. 3. Microphoto Pl. XXXIX, figs. 19, 20.

The dimensions are:

Cercariae.

	Living
Length of tail	275
Breadth of tail	60
Length of furca	240
Length of anterior organ	50
Breadth of anterior organ	50

On all essential points this species is identical with *C. vivax* Sons. and perhaps cannot be regarded as specific. The dimensions are the same. Referring to the description of *C. vivax,* I shall only mention the differentiating points in the following.

The anterior organ is of a somewhat different form, more pyriform, tapering behind. There is a prepharynx, and the pharynx itself is larger than in *C. vivax*. The two intestinal coeca are about twice as broad as in *C. vivax*, and the borders show deep incisions which give the coeca a very characteristic aspect; whereas the coeca in *C. vivax* are almost equally broad throughout their length, they are here broader anteriorly and much smaller behind. The head glands are strongly developed, and appear as two large clustershaped organs filling most of the space between the pharynx and the skin. The excretory system is of quite the same type as in *C. vivax*, but I have here seen the posterior branch which is given off at the point where the transversal commissure joins the outer canal. I have not been able to see the flame cells as distinctly as in *C. vivax;* but most probably the number is the same. In the tail I have only seen one pair of flame cells, but most probably there are more.

The host is *Bithynia tentaculata*. The Sporocysts are of quite the same shape and size as in *C. vivax*. — The species was found in *Bithynia tentaculata* at Hellebæk 15/V 1932, but only in one specimen out of 75. — During the time from 15/V to 28/V the snail ejected very many Cercariae daily. The peculiar form of the intestinal coeca was common to all specimens. —

The future must decide whether this Cercaria is identical with *C. vivax*.

Cercaria No. 4 Petersen. Host: *Bithynia tentaculata.*

Pl. XXVIII, figs. 4—6. Pl. XXIX, fig. 2.

The dimensions are:

Cercariae.

	Living	Preserved
Length of body	275	164—175
Breadth of body	155	89—98
Length of tail	250	236—251
Breadth of tail	55	25—35
Length of furca	285	214—227
Length of anterior organ	75	..
Breadth of anterior organ	65	18—19

Fully extended the furca and body are almost of the same length, the tail may be a little longer. In its broadest part the body is three times as broad as the tail. The body is incapable of being contracted to the breadth of the tail, and is remarkably flattened. It has a yellowish opaque colour which prevents a clear view of the internal structure. The tail is not inserted at the posterior end of the body but remarkably high up on the dorsal side (Pl. XXVIII, fig. 5). The anterior organ is almost circular, large, protrusile; a forepart which is almost always carried protruded is spinose and furnished with 6 openings, 3 and 3 in 2 rows; they are without doubt openings for the head glands (Pl. XXVIII, fig. 5). The whole forepart of the anterior organ is spinose. On the sides are seen peculiar strings, three on each side. I am unaware of their function. The head glands appear as two large cluster-shaped organs; as there are 6 openings, they may probably be divided into 2 × 3 pairs, but I have been unable to see this.

After the anterior organ follows a thick globular pharynx; there is no oesophagus, or at any rate only a very short one. The intestinal diverticula begin immediately after the pharynx; they are very wide, widest in the middle line and tapering slightly behind; they reach the bladder; the contours show a somewhat sinuous course. In the yellowish animals they shine with an almost silvery sheen. The cell structure is very conspicuous. No trace of a ventral sucker has been observed, and no cystogeneous glands. The bladder is broad, extended transversally. I presume that the excretory organ is built in accordance with the normal type for the *vivax* group, but owing to the opacity of the Cercaria I have only seen the outer excretory canals, not the inner ones, and not the transversal commissures. The posterior excretory tube in the tail reaches the furca and divides there, but I have not with certainty seen if the branches open on the tips. Only a few vibratile tags have been seen, and none in the tail. The tail has a layer of circular muscles and a layer of oblique longitudinal muscles. The excretory tube has an irregular coating of parenchymatous cells. When studying the living Cercariae, I often saw how this string, the excretory tube with its coating of cells, was lifted up towards the anterior part of the tail by means of the oblique longitudinal muscles, and again lowered to the posterior part. When lifted, it could be seen that the whole string was connected with the point where the rami diverge by means of a fine muscle thread; in that position the course of the string was sinuous. The motion was seen in many of the Cercariae. I have never seen this before. — The furca is very long and the rami are remarkably thin and without finfolds but with smale spines along the margin of the rami. — One more peculiarity may be mentioned. Along the borders of the body lie a series of 12—15 bright, clear bodies with a dark point. I am quite ignorant of their function. —

The host is *Bithynia tentaculata*. —

In one of the specimens the long, quite empty, mother sporocyst was found. It was greyish dark, thick-walled and almost motionless. The daughter sporocysts were remarkably short, and with power of motion. They contain enormous amounts of Cercaria brood in all stages of development. In one of them was found a creeping Tetracotyle only rarely found in Furcocercaria-sporocysts. —

Owing to the peculiar connection of the tail with the trunk, the structure of the alimentary canal, the absence of a ventral sucker, and the peculiar organs along the lateral edges of the body, there can be no doubt that the Cercaria differs specifically from *C. vivax*. It seems to show great affinities with a Cercaria found by Petersen in *Paludina vivipara*. The insertion of the tail is the same, and there is no sucker. Since the figure as well as the description is very inadequate, and since my own, too, lacks important particulars, I consider it most correct to refer my specimens to his form.

It must be admitted, however, that it shows great similarities to the "Tetis" group of Sewell (1922, p. 291) viz. *Cercaria indicae XXXIII*: Pale yellow colour, rounded refractile cells along the lateral margins of the body, spines along the margins of the rami, but no finfolds, no trace of an acetabulum, an excretory system of a more simple structure than that of *C. vivax*; but only the future can decide whether it belongs to this group. —

Cercaria No. 4. Petersen was first observed in unripe stages in *Bithynia tentaculata* from Furesø on 13/V 1931. It was only found in a single snail. It was then found again on 19/IX 1931 in 2 of 120 specimens from Furesø at 3 m. On 11/V, among 150 specimens of *Bithynia tentaculata* from 4 m, I found one individual which contained Furcocercaria sporocysts with unripe Furcocercaria brood; the broad intestinal diverticula left no doubt that the Furcocercariae belonged to the *vivax* group, and owing to the short Sporocysts I suppose them to be referable to this form.

Cercaria Apatemon (Strigea) gracilis Rud.

This Cercaria, which develops in *Bithynia tentaculata* and encysts in fresh — water hirudinea (*Herpobdella atomaria* Car. and *Haemopis sanguisuga*) has been described and studied in its development by Szidat (1929 a, p. 133; 1931 b, p. 160). It is mainly characterised by having four pairs of penetration glands behind the ventral sucker. It seems to be nearly related to *C. burti* Cort, North America. It is a plancton organism but is found near the bottom; it leaves the snail mainly in the afternoon and in diffuse light, phenomena which all seem to be correlated with the life of the secondary host, the *Hirudinea*. —

Apart from the *vivax* group, I have never found Furcocercariae in *Bithynia tentaculata* and never seen *C. Apatemon gracilis*. Nevertheless, I suppose that it will be found in Danish freshwater. For more than once I have found *Tetracotyle* in *Herpobdella*, and these Tetracotyles seem to be identical with those shown in fig. 7 of Szidat's paper. I therefore regard it as most correct to include this form among the Danish Cercariae. Now and then I have supposed that *C. longiremis* n. sp. (mentioned p. 113) also found in a prosobranchiate snail (*Valvata piscinalis*) was perhaps identical with *Cercaria Apatemon gracilis*.

Chapter VIII.

Biology of the Furcocercaria.

The Lophocerca group.

Pl. XXXV, fig. 14. Microphoto Pl. XXXIX, fig. 22.

Referring the reader to p. 100—103. I shall here only point out that the Cercariae of this group are true plancton organisms which stand suspended in the midmost water- layers ready to jump to fishes, especially Cyprinidae, whose skin they pierce, thereupon making their way into the blood-system where the development is completed. As is the case with the next groups, there is no intermediate host.

The behaviour of the *Cercaria cristata* larva has been studied by means of the aquarium-microscope, but especially with the Edinger-apparatus on a white reflector. Water teeming with *C. cristata* larvae was poured into small glass boxes and studied in the first-named apparatus by means of orthoscopic oculars and a strong microscopical lamp. As soon as the water currents have ceased, the larvae stand still, equally distributed throughout the fluid. The position is always the same. Suspended in the fluid the whole larva body forms a strongly bent curve, whose ends may touch each other; the rami are turned upwards and spread at an angle which is almost the same in all individuals; the tail is strongly bent and the body held in prolongation of the horizontal part of the tail. In this position (Microphoto Pl. XXXIX, fig. 22) we see hundreds of larvae standing still in the waterlayers; most of them have the rami turned upwards, but if only the tail is curved they seem to be able to keep suspended in all positions. The swarm of larvae remains still. The sinking down of the larvae is so extremely slow that it is very little conspicuous in the aquarium microscope. Now and then a single larva whirls round and ascends but very soon comes to rest again. Of all freshwater plancton organisms which I have studied I know none which seems in a higher degree adapted to a pelagic life.

The peculiar hyaline dorsal crest unique among the Cercariae has often been studied and drawn; its significance has never been understood. To me it was quite natural to regard it as a floating organ which was designed to augment the cross section resistance and in this way counteract the fall. As long as we only study the larva under a common microscope and under cover, we can get no understanding of its significance. We then see the larvae as they almost always are drawn with the body turned upwards, the tail straight and the furca turned downwards; the body and tail lie in prolongation of each other (La Valette a. o.). In this position the larva dies and is preserved. In this position the crest can have no floating significance at all. If, however, the hundreds of suspended larvae are studied under the aquarium microscope the body will appear as a thick rod-like mass and on closer observation we see that behind it has a hyaline, very thin, thornlike process, Pl. XXXV, fig. 14. In other words, this means that we see the body from the edge. The thornlike process is the hyaline membrane as seen anteriorly from the edge. Now its significance as a floating organ is intelligible.When the whole body is strongly curved the forepart with the crest is held horizontally. In this position of the body it augments the plane upon which the larva rests suspended and acts as a pronounced floating organ. —

If now we continue our observation in the Edinger apparatus we shall here simultaneously observe thousands of larvae upon the reflector. They all hang suspended in the above-described position; they form an open circle; in all specimens we see the body from the edge and the hyaline "thorn", i. e. the edge of the dorsal floating membrane, from the edge.

Among the thousands of individuals there are always some which suddenly leave the floating position and whirl upwards. Upon the reflector they ascend about a decimetre, whereupon they again remain suspended. During the whirling ascension it is plainly seen how the Cercaria, which is now rod-like with the tip of the furca turned upwards, rotates round itself, not describing an eight as most of the Furcocercariae, but only a circle; the number of rotations is remarkably small, only four to five. Quite suddenly the rotations cease, the tail is curved, and we see how the body, where the tail is inserted, invariably twists round; at the same moment the organism floats; very slowly the larva sinks downwards. Upon the reflector the same larva can be followed; it seems as if its life is divided in spells of rest during which the body slowly sinks and which last about one minute and spells of active vertical motion during which it rotates round its own axis; this period only lasts a few seconds. — The factors — external or internal — which release the active motions and the resting periods, bringing the one to an end and causing the other to begin, are unknown; what arouses the interest of the observer is the extreme suddenness with which both periods are introduced. The life of the larva, which does not last more than 24 hours and most probably less, may be described as an uninterrupted jumping during which the periods of suspension are about 20—30 times longer than the jumping period. There can be no doubt with regard to the significance of the motion. Sooner or later the larvae are to be transferred to a fish. Extremely small and quite hyaline as they are it is quite incomprehensible how they can be observed by the fishes; they can only reach them by chance, either when they bump directly against one or when they are caught by the waterstream over the gills. — The latter way seems to me to be the most comprehensible. In November 1933 I again brought *Carassius* and *Leuciscus* species into swarms of *C. cristata;* the fish does not seem to be in any way affected by the larvae. The fishes are not killed in the course of 15—20 minutes as is the case with *Cercaria C. Szidat.* They lived in my aquaria together with *Limnaea stagnalis* throwing out the Cercariae in such quantities that the water may have a milky tint. In the course of 24 hours, however, they got very sluggish; they only moved when touched and when they were then brought into other aquaria they invariably died in the course of 1—2 days; why the fishes from June 1932 (vide p. 103) were not affected I do not know.

According to Ejsmont (1926, p. 944) three species of *Sanguinicola* have been described: *Sanguinicola inermis* Plehn, only found in *Cyprinus carpio; S. intermedia,* only found in *Carassius carassius,* and *C. car. auratus* and *S. armata* Plehn, only found in *Tinca tinca.* Since my species affects *Carassius carassius,* it is possible that the larva belongs to that species, but as far as I can see it is very difficult, according to Ejsmont, to distinguish the species in the *Cercaria* stage.

The Ocellata group.

Cercaria ocellata.

During the last forty years Trematodes living as parasites in the blood vessels of mammals and birds have been found in the different parts of Europe. Mathias (1930 b, p. 152) enumerates about 12 finds. These Trematodes, belonging to the family *Schistosomatidæ* have been described in monographs by Price (1929, p. 1). For a long time their development was totally unknown. This was all the more regrettable since, as is well known, it was to the same family that the *Bilharziosis*-producing Trematodes of the East and of the tropics belonged.

Among the many different Cercariae described from Europa a single one, *Cercaria ocellata,* already described by la Valette de St. George from Germany in

1854, deviated very conspicuously from all other European Cercariae, but not until 1931 (a) did Brumpt show that it belonged to *Trichobilharzia ocellata*. In 1929—30 Brumpt found the Cercaria of *Schistosoma bovis* Sonsino in Corsica, and in 1929 Szidat found the Cercaria of *Bilharziella polonica*. Only these three Cercariae belonging to the family *Schistosomatidae* have hitherto been found in Europe. In America Cort, Faust and Miller, in Asia especially Sewell, have found other forms.

They all belong to the group *brevifurcate apharyngeate distome cercariae* of Miller (1926, p. 66) to whose paper I refer the reader. The Cercaria of *Schistosoma bovis* whose development has been carefully studied by Brumpt (1930 b, p. 17; 1930 a, p. 263) is very nearly related to the pathogenic Cercariae of man; the other two differ in essential points, especially in having well developed eyes which are absent in the Cercaria of *S. bovis*.

Since it has now been shown that one of these Cercariae: *C. ocellata* causes the outbreak of dermatitis in bathers and this dermatitis has been hitherto regarded as caused by insects, by specific qualities of the water, or by water plants, and furthermore that both *C. ocellata* and *Bilharziella polonica* have been found in Denmark, I have gathered from the literature all that we know with regard to these interesting Trematode-larvae. This is all the more justifiable since also in Denmark in 1931 there was an outbreak of dermatitis which was most probably caused by *C. ocellata*. At a moment when I had already found *C. ocellata* and expected accounts relating to outbreaks caused by attacks of Cercariae, I had heard nothing about such attacks. Those who were asked regarded water insects as the cause of the outbreak. — With regard to the outbreak of dermatitis caused by Cercariae in Europe it should be remembered that the dermatitis is of very short duration; as far as we know, the Cercariæ piercing the skin of man have pierced the skin of a wrong host, their real hosts being birds. In man they are unable from causes unknown to us to penetrate deeper into the veins and be carried with the blood into the mesenteria. They are unable to produce *Bilharziosis* and most probably die beneath the skin without reaching maturity.

Especially with us, who are near the northern limits of the molluscs in which they live, their pathological significance is most probably very small.

For a long time it has been well known that bathers in inland lakes often ran the risk of incurring rather unpleasant attacks of dermatitis. These outbreaks were familiar in almost all parts of the globe. Vogel (1930 b, p. 6) enumerates a series of observations communicated to him from physicians that bathers in the lake district of Holsten contracted a dermatitis with strong prickling and tingling sensations; the skin became covered with small papules, and a strong itch might last for some weeks. Then the outbreak diminished and later on did not give rise to complications of any kind. For a long time the phenomenon has been well known in Switzerland and was here named "Hundsblattern" or "Aareausschlag". Naegeli (1923, p. 1121) says that in Switzerland "da und dort wird mit Ausnahme der grossen Städte vor dem Baden wärend der Hundstagen gewarnt"; the reason given is that "es entstehen Hautausschläge ("Flechten"), schwere Krankheiten oder ganz einfach es sei gefährlich". Nägeli has gathered a series of observations from the different parts of Switzerland and Germany, and Christenson and Green (1928, p. 573) on the "Swimmer's itch' from Minnesota. Matheson (1930, p. 421) and later on Taylor and Baylis (1930, p. 219) have mentioned and thoroughly studied the outbreak of rashes which appeared on the bodies of persons who had bathed in the bathing pool in the Road Park Lane near Cardiff. The bathers had observed that the skin under their bathing costumes was not nearly so much affected as the exposed parts of the body. Similar outbreaks are well known from other parts of the world too. In Japan Narabayshi (1917) has shown from his own experience that it was the Cercaria of *Schistosoma Japonicum* which caused the outbreak. A special dermatitis independent of *S. Japonicum* the "Kabure of Japan" is described by Miyagawa (1913). According to Vogel (1930 b, p. 9) the Europeans in Assam when wading are exposed to the so-called "water sores". Ashford and Guitierrez mention a dermatitis (*Mazamorra*) which mainly attacks the feet and the hands of washerwomen. Darre mentions a case from Kongo and Smith cases of ground-itch from the Southern states of North America (Vogel 1930 b, p. 9).

Cort (1928 a, p. 1027) and (1928 b, p. 388) stated a long series of dermatitis outbreaks after bathing from widely separated places in the United States, the states of Iowa, Washington, Illinois, Florida, Minnesota, Wisconsin, Michigan, "as well as Haiti and France".

It is of course a question if all these outbreaks can be referred to the same cause; many fantastic esplanations have been given, but it was Cort (1928 a, p. 1027) who first, in a paper "*Schistosome Dermatitis in the United States*", showed that outbreaks of dermatitis of unknown etiology were caused by a *Cercaria elvæ* hatched from *Limnaea emarginata-angulata* and other snails; the observation was corroborated by Christenson and Greene (1928, p. 573) for Minnesota. In the following years almost simultaneously it was shown that outbreaks of dermatitis in different parts of Germany (Vogel 1930 a, p. 577; 1930 b, p. 883); in England Taylor and Baylis 1930, p. 219) were caused by the *Cercaria ocellata* La Valette. Vogel as well as Taylor and Baylis allowed the Cercariae to penetrate the skin of their forearm. In the course of five minutes a prickling sensation was experienced, and this persisted as long as the water was allowed to remain in contact with the arm. Redness of the skin was then observed; it increased in intensity, whereupon a tingling sensation began to take the place of the prickling. The next day the irritation had increased, small papules appeared and an itching sensation was experienced. The eruption and irritation increased to the fourth day; the lesion only subsided gradually, being still very plain in four weeks' time; it had not altogether disappeared in seven weeks (Taylor and Baylis). Vogel did more than that. He had the skin with the dermatitis outbreak cut out of his arm, and cut the skin with a microtome. The series showed eleven Cercariae which had pierced the skin, and in fig. 5 he showed a Cercaria with the canal the animal had produced. Brumpt (1931 b, p. 253) also let *C. ocel-*

lata attack the arms of himself and his son and arrived at the same result as Vogel and Taylor and Baylis. The Cercaria itself was carefully studied by Mathias (1930 b, p. 151) and it was shown that if it was not identical with *Cercaria elvae* it was at all events nearly related to it. Ssinitzin (1909 a, p. 299), Mathias (1930 b, p. 158), Vogel (1930 a, b) and Taylor and Baylis (1930, p. 231) have all tried to find the adult worm belonging to *C. ocellata*. Brumpt (1931 a, p. 612) succeeded in infecting ducks and refers the Cercaria to *Trichobilharzia kossarewi* described by Skrjabine and Zakharow (1920). The name of the Cercaria was then altered to *Trichobilharzia ocellata* (La Vallette 1854, Brumpt 1931 a). Brumpt says: "Les vers adultes extremement grêles vivent dans les vaisseaux superficiels de la muqueuse, où ils s'accouplent et pondent, ainsi que dans quelques vaisseaux mesenteriques." Brumpt has furthermore hatched the eggs and gives a drawing of the Miracidium. It shows no predilection for special snails, it was only absolutely negative towards *Bithynia tentaculata*. Whereas *L. stagnalis* seems to be its natural host in Nature, in the aquaria the affinity was strongest for *Planorbis corneus?*, *P. rotundatus* and *L. palustris* in which *C. ocellata* is not found in Nature. —

As mentioned above, *C. ocellata* has only been found in a single pond, Hørsholm Pond, about 10 km. from Hillerød. Curiously enough, the main host was here *L. ovata*, but it was also found in *L. stagnalis*, not in *Planorbis corneus* which harboured *Bilharziella polonica*. A large *L. stagnalis* was taken on 2/VII 32 and died on 16/VII. Every day the snail threw out enormous quantities of Cercariae; on dissection it turned out that the whole animal consisted almost entirely of enormous quantities of very long Sporocysts. — The life of the Cercaria was studied; on all essential points I can only corroborate the observation of Ssinitzin (1910 a) and Mathias (1930, p. 156). When the Cercaria leaves the snail, it swims about eagerly in the water for a short time; it is strongly phototactic, and seeks the lighted side of the vessel on which it fastens itself. It adheres by the ventral sucker, the forepart is commonly kept free of the substratum and the tail with the furca streched out perpendicularly in the water. It may move a little, but it almost always remains motionless, attached to the substratum. When the vessel is turned round the Cercaria will go off and again seek the lighted side. They live about $2^1/_2$—3 days. Occasionally I have seen a Cercaria turn round when fastened with the ventral sucker; now and then the tail and the furca are moved laterally, but commonly the Cercariae remain motionless. In Pl. XXVIII, fig. 7 I have given some sketches of the most common positions I have observed. In Nature the Cercaria may be attached to the vegetation, and may be present in enormous numbers where snails are strongly affected. As already Ssinitzin (1909 a, p. 315) has observed, the Cercariae do not prefer the surface, as is the case with *Bilharziella polonica*. Most probably they anchor themselves in the neighbourhood of the *Limnaea* from which they are thrown out. Like Ssinitzin I have seen at the bottom of the vessels in which infected *Limnaea* were kept "unterirdische Wälder aus den senkrechtstehenden gabelformigen Schwänzchen der Cercarien". In contact with the human skin they pierce it and cause the now well-known dermatitis. In that case they have entered a wrong host and die there without attaining maturity. When ducks are lying in infected vegetation, they are infected, and in these hosts they reach maturity. —

At Hørsholm there are very many ducks and some swans. I have enquired whether any sickness had been observed among the birds, but this was denied.

Cercaria Bilharziellae polonicae.

Bilharziella polonica was first found by Kowalewski (1895, p. 1, 1896, p. 146) in the blood of some ducks from Poland; later on he found this very peculiar Trematode in *Anas boschas, A. acuta, A. querquedula, A. crecca, Fuligula leucophthalmus* and *Mergus albellus.* He called it *Bilharzia polonica.* Loos (1899, p. 521) referred it to his new genus *Bilharziella.* Th. Odhner (1913, p. 54) found it again once in *Fuligula cristata.* Szidat (1928 a, p. 331, 1929 b, p. 78) found that the parasite was extremely common in *Anas boschas* and in domesticated ducks. — The development had been entirely unknown till Szidat (1929 c, p. 461) showed that the Cercaria developed in *Planorbis corneus* and thoroughly studied its biology.

As mentioned above, I have found the Cercaria in three different localities, always in *Planorbis corneus.* It was a fact of peculiar interest that the *Limnaea ovata* and *Planorbis corneus* in Hørsholm Pond collected on the very same day and over the same square metres gave: the former *C. ocellata,* the latter *C. Bilharziellae polonicae.*

With regard to the biology of the Cercaria I can only corroborate the excellent observations of Szidat. As soon as the Cercariae come out from the *Planorbis* they so to speak dart to the surface; their feeble tail and very short rami plainly show that they are neither swimmers nor pelagic organisms. Arrived at the surface they fasten themselves by means of the ventral sucker, and in very many cases the tail breaks off; if not, the tail hangs down perpendicularly from the surface. If this is agitated, the tails move forwards and backwards. As Szidat has observed, the whole surface is in a very short time covered by a gelatinous matter produced by the Cercariae and forming a layer common to all the Cercariae (Microphoto Pl. XXXIX, fig. 21). If this matter is produced by the penetration glands or by cystogeneous glands near the anterior organ is doubtful. This strong production of gelatinous matter is unquestionably of the greatest significance in the biology of the animals. Swimming birds which come in contact with this layer with its great number of Cercariae will get the membrane with the Cercariae on their feathers, from which the Cercariae pierce the skin. Szidat (1929 a, p. 86) poured water with these Cercariae over ducks which were free from parasites; 10—12 days later *B. polonica* was found in the veins of the mesenterium.

Of course *Bilharzia* epidemics have been feared in Europe, but the danger of such is but small. Prætorius (1929, p. 2055) has shown that *Planorbis corneus* and our *Limnaea* species cannot be attacked by the Miracidia. The chief host, *Bullinus contortus,* does not occur until Corce where Brumpt (1929 a, p. 879) succeeded in infecting *B. contortus* with *S. bovis*, the same which is the main host of *Schistosoma haematobium* in Africa.

Lutz (1921 b, p. 119) has shown that the Miracidia of *Schistosoma Mansoni* chiefly attack the antennae of *Planorbis*. They produce a local reaction characterised by swelling and hyperaemia, which is easily observed owing to the red colour of the blood in the larger *Planorbis*. After three or four days, when the Sporocysts begin to develop, a secondary swelling of the antennae takes place, which increases during the first fortnight. "About twenty days after the infection the antennae become pale and shrunken without disappearing altogether; therefore the infected snails may be recognized even after a long time." Lutz (Pl. 38, figs. 20—38) gives a series of figures of deformed antennae. I have searched without success for specimens of *Planorbis corneus* with deformed antennae. As stated above, my material was very small, but I take the liberty of calling attention to the observation of Lutz; the attack of *Bilharziella polonica* may possibly produce a similar effect on our *Planorbis* species.

It is a familiar fact that the known blood-infecting Trematoda belong to three families: the *Schistosomatidae*, the *Spirorchidae*, and the *Aporocotylidae* (= *Sanguinicolidae*). The *Spirorchidae* all occur in turtles (N. America), and are very common there (100 p. c.). While the two other families are hermaphroditic, the *Schistosomatidae* are the only known digenetic Trematoda possessing separate sexes. The cause of this dioecia is difficult to understand. In a very interesting paper Stunkard (1923, p. 165) has put forward the conjecture that the dioecia is connected with the appearance of vertebrates with a complete separation of arterial and venous blood; the blood flukes then leave the arteries and go in search of the venous blood which is richer in nourishment. This circumstance, and the fact that the blood of homoiothermal vertebrates contains more oxygen is surmised to be the cause of the dioecia.

Cort (1921 a, p. 226) has shown that all Schistosomatidae originating from a single Miracidium are of the same sex. Faust (1927 a, p. 169) points out the epidemical significance of the fact with regard to *Schistosoma japonica* in China. According to Severinghaus (1928, p. 653) all the Cercariae of a snail may develop into Trematoda of the same sex. If male Trematoda only are brought to development in a host (a marmot), the development will be normal; if female Trematodes alone are brought to development in a host, the females will not be fully developed: the growth will be arrested and the sexual organs remain undeveloped. If after a while the marmot is infected with male Schistosomes, the development will proceed and the females become normal.

These very interesting experiments are mentioned here because it would of course be desirable to ascertain whether our own European Schistosomatidae would behave like the pathological ones. The same applies to the interesting investigations of Lutz (1921, p. 109) with regard to the thickness of the antennae of *Planorbis olivaceus* caused by the development of Sporocysts of *Schistosoma Mansoni*, and to Brumpt's studies on egg-laying processes in Schistosomes (1930 a, p. 263). Investigations on the behaviour of the European Schistosomatidae have not, as far as I know, been carried out.

The Strigea group and the Proalaria group.

The development of the Trematoda with a typical Furcocercaria stage (not a *Bucephalus, Cystocercaria* or *Lophocercaria* stage) is among the most complicated of all Trematoda, and in the whole animal kingdom. These Trematoda use at least three different hosts perhaps, and there is some evidence for the supposition that they may use four; however, whether this case is normal or only a result of an individual abnormal line of development is, as far I can see, not fully elucidated. The unusual feature in the normal development for all these forms is, that between the Cercaria stage and the mature stage there is intercalated a new larval stage, differing very much from the normal larva stage, the Furcocercaria, as well as from the mature form, a stage which looks very different in the different forms and which, therefore, has many different names (*Diplostomum, Tylodelphys, Tetracotyle, Codonocephalus, Neascus*). It has been experimentally shown that the *Diplostomum* and *Tetracotyle* stage is preceded by a Furcocercaria stage; with regard to the others we merely possess suppositions. —

It is these new larval stages which for their development demand a second host, commonly a snail or a fish; with regard to Tetracotyle it is the peculiar occurrence of this stage in very many different animals which allows the supposition of a third one before the last one is reached.

a. The Strigea group.

For almost exactly a hundred years, from the date when Nordmann in 1832 wrote his Mikrographische Beiträge to the most recent investigations (Braun 1894 a, p. 165; 1894 b, p. 680; Faust 1919 c, p. 69; Lutz 1921 a, Ruszkowski 1922, p. 237; Mathias 1925, p. 1; Szidat 1923—31; La Rue 1926—32; Haitsma 1929, p. 224, 1930, p. 140; 1931, p. 447; Harper 1931, p. 310) research has tried to solve the question of the development of the Holostomatidae. The course which science has taken has in reality been one of uninterrupted trials and errors, and it almost seems as if the greatest errors are closely associated with the greatest names in parasitology. At all events these eminent parasitologists have with more or less hesitation endorsed different theories which succeeding investigators were forced to abandon. A full historical account of how our knowledge has developed has often been given (Huges 1928 f, p. 502; Mathias 1925, p. 22; Szidat 1929 c, p. 614; of the mature forms by Hunter 1929, p. 104).

It was the Danish Zoologist Abildgaard (1790, p. 24) who first of all created the genus *Strigea;* Steenstrup (1842, p. 46, Pl. III, fig. 5—6), as many others after him, found Tetracotyle in parthenitae of other Trematoda and gave some figures of echinostome Rediae with enclosed Tetracotyle. He regarded them as genetically related to those Trematoda in whose parthenitae they were found. The idea was accepted by Filippi who created the name *Tetracotyle* (1854, 1855 and 1859), and this in spite of the fact that Siebold already the next year after the appearance of

Steenstrup's famous work (1843a, p. IXXXIII and 1843b, p. 325) alleged the incorrectness of Steenstrup's view, an opinion later on adopted by Moulinié (1856, p. 150), Pagenstecher (1857), and others. Moulinié quite correctly held that the occurrence of Tetracotyle in the Redia was entirely accidental; and that this Tetracotyle "soit une forme plus petite aquatique qui s'introduit dans les Mollusque, comme en plupart des cercaires, en se frayant un chemin a travers les tissus".

At that time no one had any idea to which Trematode these larva stages belonged. It was Ercolani (1881, p. 287) who showed that ducks fed with Tetracotyle got adult Holostomes. A great step in our knowledge of the development of the Holostomes was thus taken, since it was now established that the Holostomes pass a Tetracotyle stage. It must, however, be noted that already v. Linstow (1877a, p. 195) supposed that "die Genera Tetracotyle und Diplostomum den Larvenzustand von *Holostomum* darstellen". That it took about 50 years before the main lines in the development of a Holostome were cleared up was, however, due to a wrong theory based upon insufficient observations, but nevertheless, even though with some doubt, accepted by the first authorities on parasitology.

Already in 1877a v. Linstow (p. 195) had studied Miracidia developing from eggs of a Holostome (*H. cornucopia* Molin). A resemblance, which nowadays seems very superficial, led v. Linstow to the supposition that the Tetracotyle developed directly from eggs. The development of the Holostomes was supposed to occupy an intermediate position between the other digenetic Trematoda and the Polystomes. On the one hand, there was no development in Sporocysts and Redia, but on the other hand the development was not a direct one because between egg and mature form there was intercalated an encysted stage, the Tetracotyle stage. The hypothetical supposition of v. Linstow caused Leuckart (1886—1901, p. 163) to set forth the theory that the Holostomes had an alternation of hosts, but not of generations, and he called the development of the Holostomes metastatic. The theory was accepted by Brandes (1890, p. 570) and Braun (1892, p. 796) and was universally current till a new significant step was taken by Lutz (1921, p. 124). He showed that Furcocercariae, developed in threadlike Sporocysts, metamorphose into a Tetracotyle stage, in other words that Moulinié's supposition was correct. The next year Ruszkowski (1922, p. 237) showed for *Hemistomum alatum* that eggs of this worm in fresh water snails developed in Sporocysts in which Furcocercariae later on appeared. The development of all these forms was now cleared up in all its essential points, but hitherto no one had followed the development of a single species from egg to mature worm. This was done by Mathias (1922, p. 175 and 1925, p. 14) and by Szidat (1924, p. 299; 1929e, pp. 612 and 686). Szidat saw his Cercaria *A.* penetrate into the skin of *Lymnaea palustris* and studied its transformation into *Tetracotyle typica* Filippi, determining the adult form as *Cotylurus cornutus* (Rudolphi) and regarding *Strigea tarda* as a synonym for *Strigea (Cotylurus) cornuta* (Rud.). The cycle of *Cotylurus cornutus* has therefore the following course. From an egg thrown out into the water with the excrements develops a Miracidium which pierces the skin of a *Limnaea palustris*. Here it alters into a mother sporocyst in whose interior daughter sporocysts are developed; the Sporocysts propagate by division and produce in their interior a series of daughter sporocysts in which sooner or later Furcocercariae develop. These Furcocercariae leave the snail, whereupon they again make their way into another specimen of the same species, and in the genital organs develop into the creeping Tetracotyle stage described by MATHIAS and SZIDAT, which, again, is changed into the immobile stage that, when swallowed by waterbirds, passes into the mature one.

In his excellent monograph of the genus *Strigea* (Abildgaard) SZIDAT (1929 c, p. 736) shows that the same Tetracotyle stage, *T. typica*, is also found in leaches (*Haemopis, Herpobdella*).

SZIDAT adds to our knowledge of the development of the free-living Tetracotyle stage from the Furcocercaria onward to the immobile stage. SZIDAT clearly shows — a fact which is of special interest — that the development from Furcocercaria to Tetracotyle must be regarded as a true holometabolic metamorphosis during which the larval organs of the Furcocercaria are broken down and new organs typical of the Tetracotyle are formed. During this time the larva increases in size, that is to say, in breadth and in length but not in thickness. As the whole alimentary canal with the suckers is broken down, the nourishment can only take place endosmotically through the skin, a process which causes the genital organs of the snail to undergo a process of decomposition and change into a slimy mass. The manner in which the old larval organs are broken down and new ones developed must be reserved for future investigations. The new suckers appear in the place of the old ones, and a little later appear the "holdfast" organ and lateral grooves of the resting Tetracotyle stage.

I shall here not enter into details with regard to the extensive literature relating to the anatomy and placing of the different larva stages of the Holostomidae; but restrict myself to refer the reader to the papers of Miller and Faust and especially to the long, very valuable, series of papers: Studies on the Trematode Family *Strigeidae* (*Holostomidae*) which under the leadership of Prof. LA RUE have contributed very much to elucidate many points in the anatomy and biology of the highly remarkable development of these Trematoda. I also refer to the papers of BRAUN (1894 a, p. 165 and 1894 b, p. 680) and CIUREA (1927 b, p. 12).

I merely wish to call attention to some points in the natural history of these animals which, as far as I can see, still need further investigation; both belong to domains widely separated from explorations carried out at a freshwater biological laboratory.

SZIDAT has clearly shown that the further development of the Furcocercariae may be regarded as a holometabolic metamorphosis. The question remains, however, why should just these Cercariae pass through this metamorphosis and a Tetracotyle stage be a necessary link in the development of the Holostomata. Why should the whole larva body be broken down and another differing in all essentials from it arise. Just as the cyst of an Echinostome, when introduced into the alimentary canal, gives the adult form, so also does the Tetracotyle. Therefore in the biology of the developmental stages a holometabolic metamorphosis does not seem to be required. Within my knowledge there is no other Trematode family in which we find so great a difference between the larva and adult stage as just in this family. This holds good especially with regard to the development of the "holdfast" organ. Even if we are unable to see just how, the impression remains that it is the development of this organ which is of chief importance during the passage from the free creeping to the motionless Tetracotyle stage. It is perhaps mainly this organ which, in contradistinction to other organs, demands a special period of nourishment characterised by the enormous growth of the Cercaria body. In my eyes it is not the resting Tetracotyle stage but the free creeping leaflike stage very variable in form and equipped with an enormous power of growth which is the most striking feature in the development of the Holostomes. When a sufficient amount of food is taken in, the development of the most deviating organ of the Holostomes, the great "hold fast"-organ, begins; the cause for the complicated metamorphosis may be found not so much in the biology of the developmental stages as in the biology of the mature stage.

With regard to the Tetracotyle stage there is still the question whether or not it takes food in its resting stage. The last supposition is, as far as I know, tacitly accepted. Surrounded as it is by a thick cuticula and by a much thicker gelatinous envelope this would also seem the most reasonable. Szidat (1924, p. 261) says that *Tetracotyle typica* not "feste Nahrung aufnehmen". It must, however, be kept in mind that the oral sucker is well developed that both envelopes have an opening anteriorly and posteriorly, that the excretory bladder functions and from time to time throws out small round or rod-like particles, especially when the organism is subjected to a slight pressure. When in spite of all probability I cannot rid myself of a doubt that the Tetracotyle in some way may influence the tissues of the snail, this is owing to two reasons. In snails which contain many hundreds and even some thousands of encysted Tetracotyle, they are always found in a yellowish-white gelatinous mass, simultaneously containing sperm masses of the snail. It is as if the whole of the genital organs, the hermaphroditic gland, the albumen glands and the duct, are in a process of jelly-like decomposition, which in some way is produced by the Tetracotyle and which may still be continued even after these have been transformed into the resting stage. Furthermore, it has struck me how greatly the resting stages differ in size. When the inner membrane is hardly developed and no sign of the outer jelly-like one is present, the size does not seem to be more than 340 μ, but among the many finished stages we find very many which may reach a length of 510. On Pl. XXV fig. 15—16. I have drawn the smallest and the largest one I have seen. In my opinion there are some reasons which speak in favour of the supposition that even in the resting stage jelly-like matter may in some way be sucked in byt he organism.

As is well known, resting Tetracotyle stages are found in very many different animals, belonging to almost all higher groups of land and freshwater organisms. They are furthermore found in almost all organs; in the muscles, in the brain etc. As the mature stages are pronounced parasites in the alimentary canal, there is no doubt that as long as the parasites have not reached it, they have not reached their final hosts. The question therefore arises if there is not, before this final host, in some developmental series intercalated a new intermediate host, or in other words, if the development does not demand four in all hosts. When for instance a Tetracotyle stage is found in the connective tissue of *Sorex vulgaris* (v. LINSTOW 1877 a, p. 191), and we know that many Holostomes are found in the alimentary canal of *Rapaces*, there is the possibility that small Insectivora and Rodentia may be a necessary intermediate stage between snail and bird; it may, however, also be possible that the occurrence of Tetracotyle in the connective tissue of *Sorex* as well as in so many other places outside the alimentary canal is only due to chance. But the question still remains how they arrive in all these organs in which the final development cannot take place. We are almost forced to suppose that the parasite has reached the place in the Cercaria stage; on the other hand, it is difficult to understand how a Cercaria should make its way into the neck musculature of *Mustela putorius* (v. LINSTOW 1876, p. 1), into the subcuticula of *Pelias berus* (v. LINSTOW 1877 a, p. 192), and into the connective tissue of *Sorex vulgaris*; into the brain of a minnow (ASHWORTH and BANNERMANN 1927, p. 159), into the brain of *Ammocoetes* (BROWN 1899, p. 489), into the Peritonaeum of *Schizothorax intermedius* (PAWLOWSKY and ANITSCHKOW 1923, p. 219). What renders the matter still more obscure is that the authors, especially the earlier ones, used the name *Tetracotyle* for very many organisms and did not even give a drawing of the stage which they found.

I have taken the liberty to call attention to these points because I think that here there are still aims for future investigations.

Cercaria A. Szidat.

It is especially *Cercaria A Szidat* which has been studied in the laboratory at Hillerød.

This species is extremely common in our country; it is perhaps the commonest of all our Furcocercariae. When a large *Limnaea stagnalis* infected with Sporocysts of this species is put into a vessel, it will sooner or later throw out enormous masses of Furcocercariae. These Furcocercariae either sink slowly downwards to the bottom, or they ascend to the surface; they are able to stand still in the waterlayers like pelagic organisms, but they are much more active swimmers, darting away in all directions. If fishes are placed in the aquarium they may live for months together with the infected snails; on the other hand, if the water with the Cercariae is poured into another vessel and a *Limnaea* e. g. *L. stagnalis* or a *L. palustris* is placed in it, the Furcocercariae will be seen to gather round the *Limnaeae*. Shortly after the *Limnaea* will be observed to make small sudden jumps; by means of a lens it can be shown that the whole animal is covered with a layer of Cercariae which are creeping everywhere upon the mantle and shell; the body is pressed against the surface, the tail is very often stretched out vertically to the body; in many specimens the tail is already thrown off. It can further be shown that everywhere the skin is in convulsive motion. The snail reacts to the attack by a heavy slime production, and in this slime very many Cercariae die.

We have here to do with one of those Furcocercariae which use the same species as primary as also as secondary host. In this case the Cercaria stage would seem to be rather superfluous, but it may be important from the fact that the material produced by the single Miracidium which once made its way through a *Limnaea* is not restricted to a single specimen but distributed over many. If a vessel contains only the very same snail which has produced the Cercariae, these attack it, but in Nature where the *Limnaea* often lie side by side and often in great numbers, this will most probably not be the rule. —

It is characteristic of all those localities where the *Limnaea stagnalis* contain *Cercaria A. Szidat* that they often also contain Tetracotyle. Through the studies of Szidat (1929e, p. 612) and others we know that Tetracotyle is a developmental stage in the development of his *Cercaria A.* found by him in *Limnaea palustris.*

I refer the reader to his account which I can only confirm and to which I have only little to add. On Plate XXV, figs. 1—10 I have given the metamorphosis in 10 figures. The figures are all drawn with the same power and show the enormous growth which reaches its climax in fig. 6, whereupon the organism again diminishes in size. In the stage given in fig. 7 the larva is still movable, in fig. 8 the motion has ceased; the thick cuticula is not found until fig. 10. The diminution in size seems to proceed at a great rate. The stages figs. 7—9 are rare. Fig. 2 represents the smallest tailless larva I have seen; the two suckers, the pharynx and blind sacks are still conspicuous. During stages 3—6 all interior organs disappear and a transversal section fig. 13 shows only many vacuoles and numerous nuclei. In all these stages the "riesige Zellen" of Szidat are found everywhere. In the stage fig. 7, and till fig. 8 is reached, the new organs of the Tetracotyle are built up again. The "holdfast-organ" begins (Pl. XXIV, fig. 12) as two protuberances which may be twice as large as is seen in the figure; later on they are invaginated in the body. Pl. XXV, fig. 11 shows a longitudinal section of a stage between figs. 7 and 8, and fig. 13 a transversal one through the holdfast organ and ventral sucker. The three figures (3—5) on Pl. XXIV show horizontal cuts of a fully developed Tetracotyle and figs. 6—7 a transversal section in the posterior part of the "holdfast" organ. — On Pl. XXXVII, fig. 12 a microphoto of a snail containing numerous Tetracotyle cut in all directions is seen; they lie in the hermaphroditic gland and it can be observed how the tissues are influenced by the parasite and subject to an intensive destruction. Pl. XXV, fig. 14 shows a Tetracotyle in a Sporocyst of a xiphidioid Trematode; the figure shows how large the parasite is in comparison with the host; furthermore it is seen that it is not nourished by the brood of the Sporocysts, which always seems unhurt; there can be no doubt that in this stage at all events it is nourished endosmotically.

The development has been studied in two localities near Hillerød, at Strødam and in Donse Pond.

In the first part of July it could be shown that the *Limnaea stagnalis* of Strødam were heavily infected with Tetracotyle. Of 10 specimens 9 were infected. The whole visceral sack was covered with yellowish white spots; when pricked with a needle, the Tetracotyle streamed out. They are often present to the number of many thousands. They occur mainly as the broad flat larvae described and figured by SZIDAT; they are very mobile and may be found of all sizes, from very small specimens to fully developed ones. In the furrow of the visceral sack, imbedded in slime, these larvae are found by hundreds. They seem to be wandering upwards into the liver where these stages also are found; if the Tetracotyle stage is reached at the moment when the snail is killed, most of this stage is found here or in the liver. They lie there in inlets; the colour of the liver is a peculiar bright yellow with a faint reddish tint. This causes the shell also of heavily infected snails to assume a peculiar yellowish red colour, most conspicuous in the upper windings. It is very fragile. To ascertain if these snails have Tetracotyle or not it is only necessary to break off a small piece of the spire and the Tetracotyle will then pour out in a stream. — Of 10 observed specimens only one had Cercariae; in this case the liver was merely an entangled mass of Sporocysts and no Tetracotyle were found.

During the period 9/IX 31 to 29/VI 32 collections were made on 9/IX, 19/IX, 20/I, 24/II, 11/IV and 29/VI. Each time 25—30 snails were collected. In every specimen Tetracotyle were found; not in a single one Sporocysts or Furcocercariae. In most cases only the parasite was found in the Tetracotyle stage; but during the whole period the flat larva stage was present and in a few snails in great numbers. From September to 24/II snails were kept in the aquaria. During the period 14/II—24/II the snails died; all contained Tetracotyle in enormous masses. Many of the snails were simultaneously infected with echinostome Rediae, and many larvae, creeping larvae as well as Tetracotyle, were found in them. Often to the number of 10, the Tetracotyle lie as pearls on a string, and the echinostome Cercariae are arranged in circles round them. I have never seen that these Cercariae produce a sickly appearance. The parasite in the Rediae may be nourished endosmotically. — By 11/IV 32, when the pond thawed, it was difficult to find many old snails; there were many empty shells; unquestionably many snails had died during winter. 10 specimens were found; 9 of these had Tetracotyle in enormous quantities; the free creeping larval stage was not found. Sporocysts and Furcocercariae were not found in a single one.

All the 10 snails observed belonged to the oldest age-class; the shell was much corroded; the spire often broken off. These snails almost all died in May-June; now a younger age-class was found, with fine brown chitine and unbroken spires. In the last part of June some specimens were found which contained Sporocysts and threw out great numbers of Furcocercariae. A few of the oldest age-class which had survived were especially heavily infected. Tetracotyle were not found in the young snails, and the infection with Sporocysts was but slight, presumably only a few per cent. In the autumn of 1932 no Sporocysts were found and the infection with Tetracotyle was by no means so heavy as in 1931. —

I suppose that in 1930—31 there has been a rather heavy infection with Miracidia and that these in June-July have produced an enormous quantity of Furcocercariae which again have produced the extensive infection with Tetracotyle. If this is right the observations are able to throw some light upon one of the significant functions of the Tetracotyle stage in the development of the *Strigeidae*. A single snail is able to produce Furcocercariae by the hundred or thousand, perhaps by the million, but more than some thousands of the large Tetracotyle a snail cannot harbour. — The parasitic life must be distributed over two specimens; it is only the want of room and the inability to provide nourishment on the part of the host which forces the parasite to seek a new host. And it would seem that a new host of the same species as the first is preferred. At Strødam *Planorbis corneus* occurs very commonly side by side with *Limnaea stagnalis; Bithynia tentaculata* is extremely common. Tetracotyle have been found in a few specimens of *Planorbis corneus* but only in small number, and never in *Bithynia tentaculata*.

Recently Winfield (1932, p. 130) and Nolf and Cort (1933, p. 38) have shown that individuals of *Limnaea stagnalis appressa* and *L. stagnalis perampla* which were infested with Sporocysts of *Cercaria flabelliformis* were highly resistant to the penetration of its own Cercariae, although these two varieties of snails serve very effectively both naturally and experimentally both as first and second intermediate hosts. The life history of *C. flabelliformis* has been worked out by American authors (Faust 1917b, p. 105, Cort 1918a, p. 49, Cort and Brooks 1928c, p. 179, Hughes 1928f, p. 495 and van Haitsma 1931, p. 447). The Sporocysts develop in the course of six weeks; they give off Cercariae, which enter the same species of snails and in the course of six other weeks are altered into mature Tetracotyle; when this stage is eaten by ducks, it is changed into the mature form *Cotylurus flabelliformis*. The species is very nearly related to the very form with which we are here concerned, namely *Cercaria A. Szidat*.

Winfield and Nolf and Cort have now shown that snails which already are infected with Sporocysts of *Cotylurus flabelliformis* are practically immune to the penetration of the Cercariae and to the development of the same species.

Winfield (1932, p. 132) maintains that this immunity plays an important part in the survival of snails harbouring this Trematode since it tends to prevent them from being attacked and overwhelmed by the great numbers of Cercariae which escape.

No doubt seems to be possible with regard to the correctness of the fact. On the other hand, there seems to be something lacking in the interpretation; in Winfield's presentation, I do not think this interpretation is quite correct I shall return to this point later on.

Wherever *Limnaea* have been strongly infected by larvae of Holostomes the percentage of snails infected by Tetracotyle has always been much larger than of those infected by Sporocysts. Of the first-named often almost 100 per cent. have been infected, of the last-named commonly only a few per cent. The Tetracotyle can be found the whole year round, the Sporocysts occur mainly in the winter months, the Cercariae chiefly in spring and summer. From this I am inclined to suppose that the Miracidia attack mainly takes place in the autumn, the Cercaria attack mostly in spring and summer; in other words, that the Miracidia and the Cercariae attack snails from two different years; the result of this being that Tetracotyle and Sporocysts of the same Trematode are only rarely found in the same snail. That the snails should be especially protected against two attacks, one by the Miracidium and one by the Cercaria, I think rather doubtful. In this connection attention must be directed towards the results arrived at by RIECH (1927, p. 283) and LUTZ (1924, p. 55) with regard to the Cercariae of Echinostomes. Both arrive at the result that the Cercariae enter the same snail in which they have been developed and I can only confirm their results. I find no indications with regard to the size of the two sets of snails in any of the abovenamed papers. Nevertheless it may be noted that even if the snails are from two different years, the difference in size may really be very slight.

I am inclined to suppose that it is not solely the infestation with other Trematoda but also the age of the snails which determines the invasion of the Cercariae; most probably they only enter young snails.

NOLF and CORT have furthermore tried to find out whether there was a non-specific immunity to the invasion of Cercariae into their normal second intermediate host infested with larval Trematodes belonging to different species. The results were variable; in some cases there was no specific immunity; in snails infected with *Schistosomatium Douthitti* a partial non-specific immunity was present.

There can be no doubt that as a rule there cannot be a non-specific immunity to the invasion of Cercariae of other species, if the snail already harbours parthenitae of other Trematoda.

All investigators agree in having observed the phenomenon which has been called double infection. For my own part I have never opened heavily infected material from a pond without finding a percentage of doubly infected specimens. The double infections consist either of two species of the same group, e. g. two sorts of Sporocysts of Xiphidiocercaria, developing quite different Cercariae or two species belonging to two quite different groups, in most cases Echinostomes together with Xiphidiocercariae or Monostomes. In these cases the Echinostomes preyed upon the Rediae or Sporocysts of the other species. That the Cercariae, belonging to the Strigeidae by no means show any tendency not to attack snails already infested with other Trematoda is shown by the fact known already to STEENSTRUP but incorrectly interpreted by him, that Echinostome Rediae often contain Tetracotyle, as is often shown too in the plates belonging to this work. As I have several times found Tetracotyle in Echinostome Rediae together with Monostomes in the same snail, *Limnaea stagnalis,* we are here concerned with a triple infestation. —

What is the further fate of these Tetracotyle? We know that they are to develop in the alimentary canal of our birds. But which are these birds? Do we find in our fauna any birds which eat these large snails, often of a length of 5 cm.? For South America LUTZ (1929, p. 131 and 1931, p. 352) has shown that the snails are eaten by *Ardeidae* which in this way become infected. There is very little bird life in the ponds at Strødam. Gulls and terns have never been seen; in the autumn *Anas boshas* remains the night over on the pond; *Fulica atra* and *Podiceps* are never seen; *Galli-*

nula chloropus breeds in an adjacent pond; herons visit the ponds regularly and now and then small waders. Frequent visitors at the shores are the common crow and various *Turdus* species. If any birds of our fauna were able to get the *Tetracotyle* directly from the snails I for my part am inclined to suppose that it would mainly be our crow birds and our *Turdus* species. Besides I suppose that the manner of infection is the same as mentioned for the Echinostomes p. 69.

In spite of the many excellent papers which have contributed to the elucidation of the development of the Strigeidae I cannot but think that it is still not fully understood. As mentioned above the Tetracotyle stage is found in very many organisms in reptiles and frogs, in fishes, in Mammals (Sorex, Mice) and curiously enough not in the alimentary canal but in the brain, the muscles, the heart, the mesenterium. I cannot see how they arrive here, what they have to do here and if perhaps some of these hosts, especially fishes, Sorex, Mice serve as a third regular intermediate host before they reach the final one (a bird of prey?). I have not tried to contribute to these difficult questions because they are too far away from the maintasks of a freshwater biological laboratory.

b. The Proalaria (Hemistomum) group.

In 1928c Cort and Brooks (p. 183) showed that in North-American freshwaters there existed a group of fish-invading holostome Cercariae which "belong to the genus *Proalaria* or to closely related genera, and that their Metacercariae are Diplostomes of the type which develop in the eyes of fish. They have a close structural resemblance; very characteristic is especially the number of penetration glands (4) and their position behind the ventral sucker. For two of them it was shown that they penetrate into certain species of fish and become localized in the lenses of the eyes, and for *C. flexicauda* the development has been traced to a Diplostomum type of larva". The authors refer the *Cercaria C.* of Szidat (1923, p. 304) to the same group. It has also four penetration glands behind the ventral sucker and Szidat (1925, p. 260) has shown that in the eyes of fishes it develops into a Diplostomum which is identical with *Diplostomum volvens*. These forms were fed to gulls and the adults were identified as *Hemistomum spathaceum Reed,* of which La Rue (1926b, p. 15) has made the type of the genus *Proalaria*. Characteristic of the *Cercariae* belonging to this group is the fact that they "have the habit of hanging quietly for most of their free life". In other words, this means that they are true plancton-organisms adapted to a pelagic life. This pelagic stage most probably does not last more than one or two days. During this stage the Cercariae must come in contact with swimming fishes; the Cercariae themselves show no activity at all. —

Combined with the observations of *Cercariae A. Szidat* these facts seem to show that within the holostome Furcocercariae of Miller's group *pharyngeate longifurcate Cercariae* two types can be distinguished: Forms which use fishes as secondary hosts and forms which use snails as secondary hosts. The former develop into the genus *Proalaria* or related genera, the latter into the genus *Strigea* or related genera. In both cases the ripe stage may occur in birds; the first group has pelagic larvae in the true sense of the word, the larvae of the second group more frequently seek the bottom and are more active swimmers. In the group whose larvae enter fish the penetration glands lie behind the ventral sucker, in the snail group whose larvae enter snails they lie before the sucker.

In accordance with CORT and BROOKS DUBOIS (1929, p. 149) has given a more schematic view of the matter, separating the Cercariae discussed into two groups, the one developing through a Diplostomum stage into *Proalaria* (*Hemistomum*), the other through Tetracotyle into *Strigea*. To the former group are referred 6 species, to the latter 5 or 6 species.

It is perhaps questionable whether the division holds good; remarks in the literature as well as some of my own observations are well able to augment a doubt. I refer especially to the remarks of SZIDAT (1931 b, p. 167). For my own part I have provisionally preferred to establish the two groups partly upon the anatomical fact that the penetration glands in the one lie before the ventral sucker in the other behind it, partly upon great differences with regard to the biology. To this must be added that the arrangement of the body spines, as pointed out by CORT and BROOKS, may be different. According to these authors the Furcocercariae invading snails have no special spines near the opening of the penetration glands, whereas they are present in the fish-invading group.

So much seems to be certain that the *Cercaria C.* of SZIDAT develops into a Diplostomum, that of *C. strigeae tardae* into a Tetracotyle; what is the life cycle of the other Cercariae, provisionally and only owing to the position of the penetration glands referred to these two groups, we do not know. The life cycle of *Cercaria C.* has been studied in my laboratory for rather a long time.

Cercaria C. Szidat.

Pl. XIX, fig. 4—10. Pl. XXXV, figs. 9—11. Microphotos Pl. XXXVII, fig. 7. fig. 8. Pl. XXXIX, fig. 23.

Since NORDMANN's famous investigations it has been known that a great many Trematodes undergo part of their development in the eyes of fishes; this inquirer alleges that he has found 58 species of Helminths in them. Without going into detail I shall merely call attention to the fact that STEENSTRUP (1842, p. 58) showed the ways or canals through which the animals had found their way to the lens. LA RUE, BUTLER and BERKHOUT have collected all that we know from literature on this point (1926 d, p. 282). Because Trematoda have been found in the human eye also, SALZER (1907, p. 19) has given a very interesting account of the pathological phenomena caused by Diplostomes in the lens of fishes, and his paper is accompanied by very instructive plates. In fishes the presence of the worms causes a protrusion of the lens through the pupil, thus producing telescopic eyes of a milky aspect. In some cases the lens was entirely absent — a phenomenon which I too have observed. The parasites are carried with the blood and lymph through the lumen of the veins. They then pierce the lens capsule and the lens, but most probably they may also enter directly through the cornea or sclera. In many cases the parasites die; the lens epithelium grows round them, so as to encyst and kill them. But even though the fishes do not always die from the parasitation, they become emaciated.

On 30/IX, 70 *L. auricularia* and one *L. stagnalis* were dredged at 2—4 m. in the Furesø. These 70 *L. auricularia* were dissected and 7 showed Furcocercariae; not a single one of them had Tetracotyle. Four had Echinostomes. The *Limnaea stagnalis* was placed in an aquarium with plants. Upon another excursion on 17/XI, 70 new *L. auricularia* were gathered at 2—4 m. in Furesø. The 70 *L. auricularia* were put into vessels with 5 in each; no plants, no food. On 20/XII, 33 days later, all had died. During the time 30/IX to 20/XII, 20 specimens showed Furcocercariae, 16 Echinostomes, 8 xiphidioid Cercariae, and only in a single specimen were found very few Tetracotyle; the others showed no Cercariae but when dissected proved in several cases to be infested with Sporocysts. Most of the snails infected with Furcocercariae showed these the first days, and were immediately isolated, on 3/XII in bright sunshine and at a high barometer two snails which had never shown Cercariae suddenly threw out enormous masses. After the first days the water was not changed in most of the vessels, but 5 snails which had fresh water every day threw out enormous amounts every day in the course of eight days; then the snails died. The temperature of the Furesø on 17/XI was 7° C. This shows that the Furcocercariae may develop and may be thrown out at rather low temperatures. Of the snails which had never shown Cercariae, four were infected with Sporocysts, containing unripe or very unripe Cercaria brood.

The above-named *L. stagnalis* from 30/IX the next day threw out enormous quantities of a Furcocercariae. This *Limnaea* was placed in an aquarium with plants. For three months till c. 1/I the *Limnaea* still threw out Cercariae; it died on 12/II 33 having lived in the aquarium from about $4^1/_2$ months. During the last two months no Cercariae had appeared. When dissected, hardly anything was left of the liver but a yellow string consisting of long Sporocysts; most of these were empty; many contained quite unripe Cercaria brood and only a few ripe ones. A regeneration of the liver had not taken place.

The Cercariae from *L. auricularia* and *C. stagnalis* were carefully studied. They are identical in all particulars and there can be no doubt that they belong to the same species; the average measurements taken from 10 specimens from the two snails clearly show that. They both belong to *Cercaria C. Szidat*. It was the same species which I found in 10 of 29 *Limnaea stagnalis* on 11/IX. Its behaviour as a free-living organism has been carefully studied by Szidat (1924a, p. 249). I fully agree with Szidat's observations relating to the swimming motion of the larva, and in this respect I refer the reader to him (pp. 251—252). As Szidat correctly infers, the specific weight of the animal must be almost equal to that of the water, merely a little higher. Indeed, like many other Furcocercariae it belongs to the most pronounced plancton organisms of the freshwaters. Like many others, they use the crossection resistance as a physical principle against the fall. On Pl. XXXIX, fig. 23 shows a photo of part of a living plancton swarm of *Cercaria C. Szidat*. When the animals are at rest the position in the water is invariably the same. The rami of the furca are spread out, almost all at the same angle. Another highly characteristic fact is that the body is bent laterally and almost always held parallel to one of the rami. It is also peculiar that the bending takes place, not between the body and the tail but in the tail itself, a little below the posterior part of the body. I have tried to find an anatomical structure which would elucidate this but have been unable to do so. When living Cercariae lie under cover, it will almost always be observed that they bend the body in quite the same manner as is shown in the photo. There is no doubt that the rami in the widely spread position act as a suspending organ, and I cannot but think that the body, owing to the curvature, may act in the same way, viz. counteract the fall more than if it was held perpendicularly. It will further be seen that the rami are longer than the tail; in dead material this is not the case; they are almost always shorter. By means of the aquarium-microscope and the Edinger apparatus, and a strong light I have studied the fall. On the white reflector the Cercariae were seen to fall 2 dm. In the Edinger apparatus a swarm of about a thousand suspended Cercariae of which now one now another whirls upwards for a few seconds is a really wonderful sight. To Szidat's description I have only one thing to add. I suppose that the rami, during the vertical motion, are held almost perpendicularly on a line with the tail. The tip of the rami turn upwards, the body is contracted. The whole Cercaria, the body, the tail, and the rami, forms a stick; during the motion upwards three points: the oral sucker, the point between body and tail, and the point where the rami are fastened to the tail, are fixed points, whereas the rest is curved from side to side (Szidat). Simultaneously the Cercaria is turned in a spiral round its own axis. If this were not the case, I suppose that the Cercaria would not be able to ascend but remain in the same place in the water. During the ascension the rami are pressed together; when the ascension ceases, the rami are spread out and the body elongated. During the vertical motion they are contracted, but in the suspended position extended to their greatest length. Under the aquarium microscope this can easily be observed and is very conspicuous in the Edinger apparatus. The observation is of significance because it shows how the peculiar development of the tail of *Bucephalus* has taken place, and thus it is seen that even small variations in the development of an organism may be of significance. In my eyes the said larva forms a link in the development the final result of which is a *Bucephalus*-larva. As another step and nearer to *Bucephalus* may perhaps be regarded the very peculiar *Dicranocercaria brachycerca* described by Mrs. U. Szidat (1932, p. 318).

Szidat has made a series of interesting experiments, which all show that the larvae do not seek out the fishes but only come into contact with them by chance. This is quite in accordance with what I have seen. When *Carassius* or *Leuciscus* species are placed in water together with a *Limnaea stagnalis*, the Cercariae do not dart at the fish; it is not covered with a coating of creeping cercariae; I have never seen a

Cercaria fasten itself to the fish; there is no doubt that most of them are drawn in through the mouth or especially enter the fish by piercing the skin.

Three *Carassius vulgaris* were placed in the vessels in which either *L. auricularia* or *L. stagnalis* were throwing out their Furcocercariae. Only a few moments after the fishes had been placed in the vessel they became extremely restless. Some already made sudden high jumps in the water and 15 minutes later some of the fishes were dead. In the meantime they were found either lying upon their side or with the ventral side upwards. They were extremely sluggish and moved only when disturbed. When they were dissected the same afternoon the tailless Cercariae where found everywhere, creeping on the gills, below the scales, in the stomach, in the heart and what was the most interesting, creeping in the lens of the eye. They were found here in a number of four to six. They had still the normal Cercaria-form; only the tail was lacking. Now and then *Carassius* were placed in the vessel in which *L. stagnalis* lived. Until 29/XII the *Carassius* always died in the course of one or two days. In other words this means that till that very day the *Limnaea* threw out its Cercariae. From 29/XII the *Carassius* showed no sign of sickness. They were always brisk and took their food (*Daphnia magna*) eagerly.

On 5/XII two *Carassius* were placed in the vessel; the very same day they were sluggish, lay upon one side and moved only when disturbed. In the evening they were placed in another vessel free from snails but with plenty of food. The first three days they were still extremely sluggish, one of them lay mainly with the belly turned upwards, both were only able to swim with the body held laterally. Equilibration was totally lost. On the fourth day one of them began to recover and on the sixth they both seemed to be quite normal and as brisk as those in the large aquarium from which the other *Carassius* were taken. None of them showed blackish white eyes; nor did the eyes protrude abnormally from the head. On 17/I they were dissected. One showed one *Diplostomum* in the left eye and 5 in the right; the other, 4 in the left eye and one in the right.

The *L. stagnalis* mentioned on p. 152 and which had lived for $4^1/_2$ months in the aquarium and whose Furcocercaria lived as *Diplostomum* in the *Carassius*, was placed on 29/XII32 with a *Carassius* which lived in company with the snail till its death on 12/II33. It showed no sign of sickness. It was dissected on 15/IX 33. In the eyes were found 3 and 2 *Distomulum*. They fully agree with those found by Szidat in the eye of *Leuciscus rutilus* from which later on *Hemistomum spataceum* is developed in the alimentary canal of gulls.

When looking for the young Cercariae which had just entered *Leuciscus* species, I was especially struck by the great numbers in the veins of the gills and in those to the heart. They were found here already by Blockmann (1910, p. 47). There is of course no doubt that these larvae are carried with the blood into the body, and that their main organ is the lens of the eye where already Nordmann found Diplostomum. Knowing la Rue's supposition (1926 c, p. 265) that the *Strigeidae* and *Schistosomatidae* are related to each other, I found it of interest that here there was a form which used the blood channels to reach its definite organ even if the blood-ways themselves are not their final home as is the case with the *Schistosomatidae*. Later on, when I had got the excellent study of SZIDAT on the development of *Apatemon gracilis* (1931 b, p. 170) I saw that he too has had the same thought, and to this last-named form has added a second form which really lives in the blood-system of an organism, viz. *Herpobdella atomaria*.

Between the development of the *Proalaria*- and *Strigea*-group there is the great difference that the Cercariae of the latter, at all events *Cercaria A. Szidat*, return to the snails again and here change into a Tetracotyle as far as I know, Diplostomum stages have never been found in snails. If, therefore, a snail has a double infection of Echinostomes and one of the other two forms mentioned here, in the *Proalaria*-infected snails the Echinostome Rediae have no developmental stages of *Proalaria*, whereas the Rediae in the *Strigea*-infected snails may be heavily infected with *Strigea* brood. — Being a real plancton organism and standing in the midmost water-layers *Cercaria C. Szidat* has no chance of infecting snails. It must pass directly into fishes. Our knowledge of the further development is but small. That the eyes of the fishes must be regarded as one of the organs in which it mainly lives is a well-known fact. Here, near Hillerød, I have found Diplostomes in many fishes from all our lakes; they are mainly found in the outer part of the lens; when not present in too high a number the fishes do not seem to suffer by the parasite. That we have to do with different Diplostomum species in the eyes of fishes is a fact beyond doubt which was already observed by NORDMANN, and here is an untilled field for future investigators. A characteristic of them all seems to be that the development goes on quite gradually; there is no holometabolic metamorphosis as in the *Strigea*-group and no resting stage with a thick cuticula; further, there is no doubt that the Diplostomes in the eyes take food. The development of the eye Diplostomes is therefore different from that of the *Strigea;* SZIDAT (1924 a, p. 260) has arrived at the same result.

In 1931, at the borders of Tuel Lake near Sorø, many *Limnaea stagnalis* were gathered, which among other Cercariae also harboured a Furcocercaria with four penetration glands behind the sucker. They were determined as *Cercaria C. Szidat*. In September 1934 passing over the outlet of Tuel Lake, Dr. BERG found under the stone-bridge five *Gobio fluviatilis* of which the four large ones all possessed blackish eyes, the fifth half-grown one seemed to have normal eyes; in one of the large ones the left eye was merely a bloody mass, the right one very opaque.

In the laboratory it was seen that the lens contained a real layer of Diplostomes; (Microphoto Pl. XXXVII, fig. 1) the interesting point was that they were present in all stages; among the very large ones were found very young ones which still possessed the form of the Furcocercaria, the penetration glands and the strongly protruding ventral sucker with circles of spines. The whole anterior penetration organ with the spines at the top was still present.

Owing to the very dry summer the outlet had stagnant water. In the place where the *Gobio* were taken there were only a few centimetres of water. Here the fishes were confined and lived there in company with the *Limnaea*. There can be no doubt that the infection was of a very late date and most probably was proceeding on the day of observation.

As already Szidat has remarked, *Proalaria* within our present knowledge possess no resting Tetracotyle stage; the development goes on without any resting stage and the animal is transferred as *Diplostomum* into the alimentary canal of waterbirds. The experiment of Szidat confirms this for *Diplostomum volvens*, the larva of *Proalaria spataceum* Rud. Originally I was of opinion that nothing could be added to the observations of Szidat; a closer examination raised some doubt on this point.

When a lens was opened and the living material studied (Microphoto XXXVII, fig. 7), it was characteristic that there was a conspicuous difference between the creeping leaf-like Diplostomum constantly altering its form and the stages which still preserved the cylindrical Cercaria form; the latter were always immobile and some of them showed that the body was drawn back from the very thin hyaline cuticula, most conspicuous in the anterior part of the body. This cuticula carries on the forepart the spines of the protrusile organ and ventrally at the top the two circles of spines characteristic of the ventral sucker. This stage which on Pl. XIX, fig. 5 is drawn with the same power as figs. 6—7 is drawn with a higher power in fig. 9. In the next stage, fig. 6 and 8, the body has its leaf-like form, most of the organs of the Furcocercaria have disappeared or are undergoing a conspicuous process of decomposition. It is as if part of the process by which the Furcocercaria body is altered into a *Diplostomum* takes place during a short resting stage; if the old cuticula of the Furcocercaria is left by an out-creeping Diplostomum I will not venture to say, but it seems to me that this really is the case. — From this young Diplostomum stage the development proceeds gradually. The young specimens show only a very inconspicuous alimentary canal in their interior; the excretory canals are merely faintly seen. The lateral suckers (Hughes; "Kopfdrüsen" Szidat) are not developed, and there is no trace of the "holdfast"-organ. Slowly all the organs of the Diplostomum now come to full development; the whole penetration organ of the Cercaria is replaced by the small oral sucker; the ventral sucker has no concentric series of spines; the intestinal coeca are filled with a greyish floccose mass, as Szidat maintains, unquestionably lens material. That the Diplostomum takes in food is beyond doubt, as also Szidat has pointed out. The "holdfast"-organ has attained its full development and at a rather early stage of the development we see the tail conspicuously set off from the rest of the body and the clefted bladder opening at its tip; the excretory canals lie wonderfully clear when the animal is pressed. Fully developed the leaf-like larva is an organism subject to incessant change of form, never at rest it may assume all forms from circular to rectangular, the body being now acute anteriorly now posteriorily. It is in this stage, we suppose, that the Diplostomes are transferred to birds.

On opening the abdominal cavity of one of the *Gobio* some oval bodies fell out into the fluid (Pl. XXXV, fig. 9, Microphoto Pl. XXXVII, fig. 8). When they were placed under the microscope I could have no doubt that I was here concerned with a cyst of a form at all events related to the Diplostomes. It was much larger; it was provided with a large "holdfast"-organ of a structure like that of the Diplostomes; the oral and ventral sucker were larger, but of the rest of the organs I could observe nothing, owing to a mass of small globules arranged in strings everywhere and hiding all other organs; when pressed inconspicuous anterior "holdfast"-organs laterally to the sucker could be observed; the whole oval body was surrounded by a thick hyaline cyst wall. On pressure the whole interior ran out between the cyst and the enclosing body. The animal when dissected out of the cyst moved slowly in the fluid. As mentioned above, one of the *Gobio* had only one eye, the other one being merely a bloody mass. When this was placed under the microscope it could be seen that of the lens there was only a thin hyaline mass left. The abdominal cavity of this specimen contained the same bodies but in this case to the number of about a hundred; some lay free, but many were fastened in rows along the alimentary canal. One of these rows is seen in the photo (Pl. XXXVII, fig. 8).

I do not venture to maintain that I had here before me the encysted Diplostomum; on the other hand it seems reasonable to suppose that this was really the case. If Holostomes, as Szidat supposed, always have to pass a Tetracotyle stage, the cyst, as far as I know, may belong to a Hemistome. It may perhaps have been another Hemistome but if that were the case, it would be strange that all the 4 Gobio with Diplostomes in the eye should have a foreign Hemistone in the body-cavity; that I should here find encysted individuals only and free-living stages in the eye; and that the number should be greatest in the individual where the lens was totally destroyed. Another possibility would be that the Furcocercariae in the lens did not form a cyst where this was not necessary, whereas a cyst was formed by those specimens which did not reach the lens but underwent their development in other organs.

That the lenses of our freshwater fishes harbour other Diplostomes than that now mentioned is beyond doubt. In the lenses of *Abramis blicca* in Frederiksborg Castle Lake on 10/III 1932 were found a few very large Diplostomes which according to the size and structure of the excretory system seem to be very nearly related to *Diplostomulum gigas* Huges and Berkhout (1928g, p. 483). As in that species, the vesicles containing calcareous concretions are not found associated with the tubular portions of the urinary bladder. As shown by Fraypont (1880, p. 429), this is the case with *D. spathaceum*. It differs from *Diplostomulum gigas* by having a much smaller number of vesicles with calcareous concretions. In Pl. XIX, fig. 10 I have tried to draw the animal.

Whether all the Cercariae which are mentioned as belonging to the *Proalaria* group really belong to this group, is of course doubtful. On the other hand, the investigations clearly show that in any case other forms also have true pelagic larvae.

Cercaria longiremis.

During my investigations of the fauna of the Furesø the dredge brought up many specimens of *Valvata piscinalis* var. *antiqua*. The snails were placed in small vessels, in the first place with the intention of studying the food. The next day one of the vessels had milky water and it could be shown that this came from enormous masses of Furcocercariae hanging quietly in the waterlayers. Being occupied with other studies I could not continue the observations. Later, during the years 1930—32, we tried to find infected *Valvata* again. It seems as if the snail is now much rarer than in 1917, and infected specimens have not been found.

On 25/VII 31 *Valvata piscinalis* was found to be of fairly common occurrence in Tjustrup Lake; it lived here at depths of from 3—15 m., somewhat deeper than in the Furesø (3—13 m.) (Steenberg 1917, p. 93).

Each specimen was placed in a separate glass at 10 o'clock. At 3 o'clock one had thrown out Furcocercariae. The gill of the snail was fully extended. By means of a lens I then saw a long thin thread slowly work its way out of one of the branches of the gill. First arrived the body of the Cercaria, then the tail; then the Cercaria remained a few seconds on the tip of the gill. Then one of the rami was freed; in the fraction of a second the other. The very same moment the Cercaria turned round; the tail described an 8 and the larva ascended in the waterlayers; immediately after it took up its floating position with the rami stretched out perpendicularly to the tailstem. Through the lens I saw the Cercariae incessantly liberate themselves; they pushed forwards now from the tip of one branch now from another. The next day the water in the vessel was milky. Within my knowledge no Furcocercaria has hitherto been described from *Valvata piscinalis*. It was described as *Cercaria longiremis* n. sp. (p. 114). Owing to the position of the penetrating glands behind the ventral sucker and the pelagic larvae it may provisionally be referred to this group together with *Cercaria C. Szidat*.

C. helvetica XXXI Dubois and *Cercaria I. Petersen*.

Two more Cercariae of those possessing penetration glands behind the ventral sucker are true plancton organisms; they are *C. helvetica 31 Dubois* hatched from *L. palustris* (Microphoto Pl. XXXIX, fig. 24) described on p. 122 and *Cerc. I. Petersen* hatched from *L. ovata* and described on p. 127. Both species when hatched hung suspended in the waterlayers; the two rami of the furca are quite motionless. Nevertheless the two species may easily, even when alive, be distinguished from each other at the first glance. Like all pelagic Furcocercariae they sink extremely slowly, whereupon they ascend rapidly some centimetres; then they again stand still, now with the rami stretched out perpendicularly from the tail. Whereas *Cercaria helvetica XXXI* keeps this position of the rami, *Cercaria 1 Petersen* moves the rami nearer to the tail so that the angle between stem and rami is not 90° but about 45° (Microphoto Pl. XXXIX, fig. 25). The difference in the floating position of the two Cercariae is so characteristic that is is easily shown in photos and this is done in Pl. XXXIX, figs. 24 and 25. Another characteristic feature is that the *C. 1 Petersen* in the position given in the photo sink slowly downwards. whereas, when they ascend, they have quite the opposite position and when in that position seem to ascend without moving the tail; with regard to this latter point I am not quite sure of the correctness of my observation.

The Vivax group.

Pl. XXXV, fig. 12. Microphoto XXXIX, fig. 19—20.

In 1900 Loos published (p. 210) his admirable description of *C. vivax* Sonsino hatched in Egypt from *Cleopatra bulimoides* Jick. In Tunis it was found by Sonsino (1894, p. 4) in this snail as well as in *Melanopsis praemorsa* L. (p. 223). Loos writes: »Malgré la grande fréquence de notre cercaire dans tous les eaux du Delta, je n'ai pu rencontrer une espèce adulte qui par sa construction interne rappelle celle de la forme larvaire en question si caractéristique« (1900, p. 223).

Within my knowledge the *Vivax* group has not been hitherto observed in Europe; owing to the incomplete provisional description it is doubtful whether Furcocercaria No. 4 Petersen belongs to this group; nor has it been observed in America. From India Sewell (1922, p. 280) describes the peculiar C. Indicae XV. It is a regrettable fact that Loos's above-cited statement as far as I know is still valid. We have not the slightest idea to what mature forms these highly remarkable forms belong. This is all the more regrettable since just these forms according to Sewell (1922, p. 286) undergo a unique development, producing Miracidia in the Sporocyst. —

Loos has not in his species observed anything of that. Everywhere in my area of distribution the *Vivax* species seem to be extremely rare; they have only been hatched from *Bithynia tentaculata;* in one case 3 in of 40 specimens, in another in 1 of 75; further in 2 of 120 and in 1 of 150. In three of the cases the specimens were unripe.

Loos (1900, p. 222) says that the free stage lasts more than two days "Elles vont flotter, pendant ce temps, comme des animaux pelagiques à la surface de l'eau et adoptent alors constamment une attitude que j'ai représentée sub no. 175 ". In this position they may remain for half an hour. As far as I understand Loos, he is of opinion that they are suspended in the water in this position. If they knock against another subject "elles recommencent à monter en haut au moyen de mouvements vifs et très rapides de la queue dont les branches sont alors accolées".

Only in one case have I seen a *Bithynia* throw out *Vivax* Cercariae. They belonged to the material from Hellebæk 25/V. The Cercariae stand near the bottom; when the vessel has been shaken a little, the whole material of Cercariae ascends in the water-layers and now assumes the very position which Loos has described and which is very similar to that of the Lophocercariae. The body is much bent and the tail with the rami extended and turned upwards. In this position they may hang suspended for a long time, whereupon they very slowly sink to the bottom. During the ascension the tail is moved in a figure 8. I have never seen them at the surface. They lived a little more than two days. (Microphoto Pl. XXXIX, figs. 19—20.)

After this has been written Abdel Azim (1933, p. 432) has shown, in a series of experiments in Cairo, that *C. vivax* Sonsino encysted in *Gambuzia affinis* and *Tilapia nilotica*. Heavily infected, the fish died. The cysts ware described. Feeding experiments were made on cats and dogs and on the seventh day Trematode eggs appeared. A dog when dissected contained numerous adult Holostomes. The parasite belonged to the family *Strigeidae* and was determined as *Prohemistomum spinulosum*

Odhner 1913. This parasite is originally described from the common Egyptian kite *Milvus milvus aegypticus* in which it is usually found in large numbers.

"This explains the great frequency of the Cercariae in the *Cleopatra* snails which are found all over the country."

The Bucephalus and Cystocercaria group.

With regard to these two groups I refer the reader to pp. 98 and 109.

If now we will survey the very different life of the 7 above-named groups of Furcocercariae and the life of their final hosts in which they attain maturity, we shall, as is so often the case, find the most incredible accommodations between the life and structure of the parasites on the one hand and those of the final host on the other. —

Two of the 7 groups: the Lophocerca and the Ocellata groups are blood-suckers, living in the blood system of Vertebrates, while the others live in other organs, mainly the alimentary canal. The first named cannot use intermediate hosts. They must actively make their way into the blood system by piercing the skin. The Lophocercariae using fishes as intermediate hosts are plancton organisms belonging to the midmost waterlayers where these hosts live; the Ocellata group using birds are adapted to life on the underside of the surface; here they fasten themselves on the plumage of waterbirds, whence they make their way to the skin. —

Those who are destined to attain maturity in the alimentary canal have two alternate ways, whether maturity is reached in cold-blooded or in warm-blooded animals. In the first case intermediate hosts are not necessary, they can be eaten directly by their final hosts and in this way reach their destination; what is required is merely that they should in some way attract the attention of their final hosts. In this group we also find the largest and most peculiarly formed Cercariae, the Cystocercariae and the Bucephalidae which are directly snapped up by their final hosts.

The most complicated life cycle occurs in those forms which attain maturity in the alimentary canal of warm-blooded animals. Very much still remains to be elucidated in this field, but at the present stage it seems that two groups may here be distinguished, viz. fish-eating final hosts and snail- and worm-eating final hosts; in both cases an auxiliary host is necessary. The first-named group has planctonic larvae which like the blood-suckers pierce the skin of fishes but do not make their way into the blood but into other organs, especially the eyes, where they wait in a new larval stage till they are devoured by a final host. The latter may be a carnivorous fish, but as a rule it is most probably a fish-eating bird (gull, tern). The last-named group have not planctonic larvae; as intermediate hosts they mainly use snails again, where they are transformed into Tetracotyle stages. As such they arrive in the alimentary canals of waders, ducks etc. either directly when the snail is eaten or when they are deposited in the detritus of the shore and with that enter the alimentary canal. The fact that many of these forms chiefly attain maturity in Rapaces, and that Tetracotyle stages are found in many snails eaten by mammals (such as mice etc.) would seem to show that the development is even more complicated than has been supposed, and that these forms require more than one auxiliary host.

Chapter IX.
Microcercaria.

Of all Cercaria groups that of the *Microcercaria* is perhaps least known to us. During the last few years many species have been described, a remarkably large number from marine snails, some of them from land snails (*C. limacis* Moulinié 1856, p. 163) and most of the freshwater forms from America and Asia. The original descriptions are usually very poor and the same may be said with regard to the drawings. The only forms known from Europe are *C. micrura* Pagst. which is the larva of *Sphaerostoma brami;* the Cercaria of *Catoptroides macrocotyle* Lühe; and *C. myzura* Pagst. *C. micrura* is found in *Bithynia tentaculata*, *C. Cataphtroides macrocotyle* in *Dreissensia polymorpha*, and *C. myzura* in *Neritina fluviatilis* (only found once). I have examined about two hundred specimens of *Neritina* from three of our largest lakes but have never found any infected. Many hundred *Dreissensia* have been kept in our aquaria, and I have looked for *C. catoptroides* whose highly remarkable life history has been studied by Ssinitzin (1901, p. 689). It seems to deviate from all other forms; the Cercaria develops in Sporocysts, the tail is short and is further reduced the Cercaria does not leave the Sporocysts. Finally, the Sporocysts with the encysted Cercariae leave the gills of the mussels, whereupon they, supercompensated owing to fat accumulation, ascend to the surface with the enclosed Cercariae there to be eaten by *Cyprinidae* in whose stomach the ripe stage is reached. In Danish freshwaters only a single species has been found whose host is *Bithynia tentaculata*.

Sewell (1922, p. 154) has tried to bring some order into the group but comes to the same sad result as others that for the present it is impossible to do so. He proposes two groups: *The Cotylocercous* group of Dolfus (1913, p. 683) consisting of marine forms and the freshwater form *C. micrura*, and the *Linearis* group, including *C. pachycera* Diesing, *C. linearis* Lespés, *C. buccini* Lebour and *C. Indicae XXXVIII*. There remains a series of forms to which the above-named Cercaria of *Catoptroidis macrocotyle* Lühe belongs. They are all forms which are insufficiently known or have only been observed once. Some of them show affinities for the *Cercariaerum-cercaria* and we shall return later to this point.

Ssinitzin (1931, p. 409) describes from *Gonabiasis plicifera silicula* Gld. (locality Oregon) a Microcercaria which encysts in *Potamobius* and attains maturity in freshwater fishes. It is the larva of *Plagioporus siliculus*. Further he mentions a Microcercaria from *Fluminicola virens* which encysts in the same snail and also attains maturity in freshwater fishes.

The main differences between the *Cotylocercous* group and the *Linearis* group is that in the former the excretory bladder is large and does not bifurcate, it almost reaches the ventral sucker and has the walls formed of a single layer of granular cells which have a glandular appearance; the tail has no pyriform glandular cells. In the *Linearis* group, on the other hand, the bladder is an elongate median cavity, and the tail is occupied by pyriform glandular cells which open distally. Moreover, an oesophagus and intestinal coeca have not been observed, whereas they are present in the main form *C. micrura*. The two species of Ssinitzin (1931) may belong to the Cotylocercous group.

The Cercaria of the genus *Paragonimus*, to which the oriental lung fluke *Paragonimus westermanni* (Kerbert 1878) belongs, is a Microcercaria according to Kobayashi (1918, p. 97) and Faust (1930, p. 215), but seems to differ much in almost all essential particulars from other Microcercaria with which it only seems to have the rudimentary tail in common; this tail differs in structure from that of other Microcercariae. The Cercaria develops in snails of the genus *Melania* and encysts in *Astacus* and freshwater crabs (*Potamon*). When the crustaceans containing the cysts are eaten raw, they are transferred to the mammalian intestine, from which the flukes make their way out through the walls of the intestine, traverse the abdominal cavity, whence they migrate upwards through the diaphragm to the thoracic cavity, pierce the pleura and pass into the lungs and the bronchioles (Faust 1930, p. 220). Ameel (1932, p. 264) found near Ann Arbor Michigan in *Pomatiopsis lapidaria* Microcercaria resembling those of *Paragonimus westermanni;* it was experimentally shown that they encyst in crayfishes (in the heart tissue, not in the gills and body muscles as is the case with *P. westermanni*). The adult worm is found in the lungs of mink, but it has been experimentally shown that it may also be found in rats and domestic cats.

It is a question whether a closer examination will not reveal the existence of one of these forms in Europe.

C. Micrura Fil. Host: *Bithynia tentaculata*.

Pl. XXXI.

The body is extremely variable in form. The dimensions are:

Cercariae.	Living
Length of body	255—450
Breadth	85—135
Length of tail	45— 50
Breadth	30— 45
Oral sucker	50— 55
Ventral sucker	50— 80
Rediae.	
	1380
	2930

The ventral sucker lies a little behind the central part of the body, it is larger than the oral one. The oral sucker has a stylet. There is a short prepharynx and an almost globular pharynx. Owing to the opaqueness of the Cercaria the rest of the alimentary canal is difficult to see, but I think I have seen an oesophagus and two intestinal coeca reaching the middle of the bladder. There are on each side four glands with long slightly curved ducts which pass forward; the connection with the stylet I have not observed with certainty. The bladder is very large with thick walls of a glandular appearance. It is of an elliptical or triangular form and almost reaches the ventral sucker; there is a small opening at the base of the tail. Of the excretory canals only two main trunks have been observed. The tail has a posterior part set off from the much larger anterior one.

I have been unable to find any bristles or spines either on the anterior part or in the middle of the animal.

The Cercaria develops in long so-called Sporocysts (Pl. XXI, fig. 2) crowded with Cercariae. It seems questionable to me whether the term Sporocyst is correct. For I have always found a very small and faintly developed structure of pharyngeal form at one end; there is, however, not the slightest trace of a gut, so most probably we have here merely an opening through which the Cercariae come out.

I regret that I have been unable to give a more thorough description. The Cercariae were only found on 18/IX 31 in a large bay of the Furesø (Pl. XXVI, fig. 1—2), in *Bithynia tentaculata*. They were only found when the snails were dissected; they then came out of the Sporocysts and crept round as Hirudineans. Most probably the animals have not been fully ripe. Provisionally I refer my specimens to *Cercaria micrura*.

On 27/IX 31 of 200 *Bithynia tentaculata* from Esrom Lake (Pl. XXXI, figs. 3—4) two were infected with a Microcercaria which agreed in all essential particulars with the specimens from Furesø; in this case too the Cercariae were not quite ripe; no specimens were found free in the snail, and the snail did not, when living, show Cercariae moving about on it or at the bottom of the vessel. Many of the *Bithynia* were simultaneously infected with a Cercariaeum, and the remarkable thing was that the Cercariaea were found in the Sporocysts of the Microcercaria (Pl. XXXI, figs. 5, 6, 8, 9) in one Sporocyst five to seven Cercariaea could be counted. Some of them crept round among the Microcercariae, but most of them were in an encysted stage surrounded by a hyaline membrane; scattered in the liver of the snail were found many encysted Cercariaea. It seems to me that this is a case analogous with the development of some of the Furcocercariae; in both cases the Cercariae pierce the same snail in which they have been developed, and show a predilection for the Sporocysts. The Furcocercaria develops into a Tetracotyle, the Cercariaeum into a hyaline cyst.

I hope the interpretation I have given of the fact is correct. I confess that it has troubled me a good deal. For in the same Sporocysts which also contained the typical Cercariaea I have found specimens with a typical microcercous tail. Some of them had a bladder of exactly the same structure as the Cercariaeum. These forms are very opaque and an oesophagus and intestinal coeca were not observed. Simultaneously with them are found other forms, a little larger, but without a tail; they have a larger ventral sucker and a very conspicuous oesophagus and intestinal coeca. In these forms I have been unable to see any stylet; they seem to be identical with those I have picked out of the cyst. (Pl. XXXI, fig. 10).

Now it is a well-known fact that the Cercariaeum stages when young may possess a short tail (mentioned by Hofman for the Cercariaeum stage of *Distomum leptostomum* (1899, p. 189)), it is characteristic of all larvae during their life in the Sporocyst; the tail may be found or may not be found when they have emerged from the Sporocyst; of 4—500 ripe specimens which Hofmann found in the intestine of *Erinaceus* 5 had still the tail. On the other hand, Loos (1894, p. 48) has stated that *C. micrura* already in the Sporocyst throws off its tail. As far as I can see, Loos has had a material very similar to mine. Loos says that "soweit ich mich erinnere und meine Aufzeichungen reichen" *C. micrura* does not leave its Sporocyst but encysts in it; he has found Sporocysts which contained encysted Cercariae only, to the number of about 40. Among many hundreds of Microcercaria in the Sporocysts I have only found 5 to 7 and often some without a tail and in the free creeping stage. Loos has also observed in the encysted stage the "ansehnliche, kugelförmige oder ovale Blase" "die von grossen cubischen und stark mit Körnchen durchsetzten Epitelzellen ausgekleidet wird".

For *Plagioporus virens* too, Sinitzin (1931, p. 417) maintains that the encystation takes place in Sporocysts. In my case there is no doubt that the Microcercariae mostly leave the Sporocysts and encyst in the tissues of the snail, and this is in accordance with the fact that *C. globipora*, in which Loos (1894, p. 48) has recognised *C. micrura*, has been found as a cyst in the foot of *L. ovata* by v. Linstow (1884, p. 141, Pl. X, fig. 26). Just as I myself so Wagener (1857, p. 103) found the cysts free in the liver, in his case in that of *L. stagnalis*.

I fully agree with Sewell (1922, p. 160) when he says that further investigations will show that the Microcercariae are related to the "Helicis" group of the *Cercariaea*.

I cannot dismiss the supposition that just this group may pass through a Microcercaria stage in their development, and I am not quite sure whether the observations mentioned here should not be interpreted in this way.

Chapter X.

Cercariaeum.

Our knowledge with regard to the anatomy and biology of the tailless Cercariae is very restricted. Most of them are most probably terrestrial; and precisely the life of the terrestrial Trematoda has been very little investigated. The discovery of four new species (Harper 1932, p. 307) together with *Cercariaeum helicis* in Scotland and Henkel (1931, p. 664) and Mattes studies on *Dicrocoelium lanceolatum* (1933, p. 227) show how much there is to do in this branch of science. Owing to our slight knowledge of the group it is almost impossible to divide it into smaller groups. Nevertheless Sewell (1922, p. 160) and Dubois (1929, p. 100) have tried to do so. Sewell proposes three groups: 1. The *Mutabilis* group, 2. The *Helicis* group and 3. The *Leucochloridium* group. The *Mutabilis* group is characterised by the development of the Cercariaea in Rediae of a very simple structure. It contains organisms mainly or exclusively developing in freshwater snails.

The *Helicis* group develops in Sporocysts; they are exclusively or mainly land forms. The best known species are *Cercariaeum helicis* Meckel and *C. spinulosum* Hofmann, whose life history has been thoroughly studied by Hofmann (1899, p. 175). The group also contains freshwater forms (*Cercariaeum Limnaei auricularis* (Filippi), *C. ancyli lacustris* Dies), and marine forms (Pelseneer 1906, p. 161), all very insufficiently known. *C. Limnaei auricularis* will be treated in the following; of *Ancylus lacustris* many specimens have been studied, but I have never found them infected with Cercariae of any kind.

The third group is *Leucochloridium;* the development of members of this group is only known for *L. paradoxum;* I refer the reader to the first part of this work. McIntosh (1932, p. 32) has described a series of new species from the Douglas Lake area and shows that now at any rate 18 species are known. Of these only the life history of *Leucochloridium paradoxum* is known. A very aberrant life history is described by Sewell (1922, p. 171) for *Leucochloridium assamense* from *Lecythoconcha lecythis* and *Vivipara oxytropis* Laktat, Lake Manipur, India. The very peculiär fact that many of the above named species are found in seed-eating birds, or in birds which have not the slightest connection with water, e. g. woodpeckers, shows that the development of *Leucochloridium paradoxum* cannot be the paradigm for the development of the whole group. Most probably it is in some way an exception and perhaps as we know it not a natural one. — Dubois (1929, p. 100) refers the *Cercariaeum* species to the five groups: 1. *Mutabile*, 2. *helveticum*, 3. *squamosum*, 4. *helicis* and 5. *Leucochloridium*. Of these 4 and 5 are identical with those of Sewell. The three others result from an attempt to subdivide Sewell's *Mutabile* group. I confess that this attempt does not seem to me a fortunate one. In our country I have found 6 species some of which, as far as I can see, are undescribed. They seem to break Dubois's division; as, however, my species are insufficiently known, especially with regard to the excretory system, I have here provisionally followed Sewell and apart from *Leucochloridium* refer all the species mentioned here to Sewell's *mutabilis* group. The structure of the excretory bladder needs to be more thoroughly studied.

Cercaria paludinae impurae Fil. Host: *Bithynia tentaculata.*

Pl. XXXII, figs. 1—6, Pl. XXXIII, figs. 1—2.

The body is covered with spines, best developed in the forepart. The dimensions are:

Cercariae.	Living
Length of body	910
Breadth	375

	Living
Diameter of oral sucker	155
Diameter of ventral sucker	155

Rediae.

Length of body	2530
Breadth	980
Diameter of Pharynx	200
Length of intestine	825

The two suckers have a slight equipment of small spines. I have not seen any stylet at the anterior edge of the oral suckers. After a very short prepharynx follows a very vigorous pharynx, broader than long, a broad rather short oesophagus and two broad intestinal coeca running not much below the posterior edge of the ventral sucker, embracing the two testes. The central sucker which is almost of the same size as the oral one, lies a little behind the ventral part of the body. The whole space bordered by the sides of the body, the oesophagus, the intestinal coeca, and the oral suckers is filled with a great mass of cells with a granular protoplasm and small nuclei. The cells are smallest nearest to the oral sucker; they may in the main be regarded as cystogeneous cells. The excretory system consists of an excretory bladder, tubular of form, often curved posteriorly; it opens with a pore at the apex of the body; anteriorly it may almost reach the ventral sucker. The two main trunks pass forwards along the ventral sucker and reach the oral sucker in large loops; here they make a loop and return. A little below the pharynx they send off a branch which divides into an anterior and a posterior branch, these branches divide again and receive small branches which carry the flame cells. The number of these cells has not been sufficiently studied. In the space between the two intestinal coeca and the ventral sucker lie the two testes, and behind them the ovarium.

The Redia (Pl. XXXII, fig. 4—5) is sack-shaped without a collar or posterior locomotoric appendages. The pharynx is small, the intestine takes up from one-third to about two-thirds of the body; it is nearly always filled with an almost black content which makes the Rediae very conspicuous. They contain 4—6 ripe or almost ripe Cercariae and several unripe ones. —

On 11/XI 31 I found in a *Bithynia tentaculata* from Teglgaardsø near Hillerød Rediae with almost ripe *Cercariaea* stages which were not distinguishable from the above-mentioned. Some of them were remarkably hyaline, and in them I saw the excretory system rather plainly. It consisted of a broader tube in the posterior part of the Redia, in the middle of the animal the tube divided into an anterior and a posterior one; the former was more straight the latter strongly curved, some few flame-cells were seen in the anterior and the posterior part, but I do not venture to give the real number with certainty.

The encystation may take place in the same snail; cysts are often found surrounded by a hyaline very thin membrane, showing in a peculiar manner the different organs. Most characteristic is the strong growth of the ovarium, the uterus and the cirrus, internally equipped with spines (Pl. XXXII, fig. 6).

The *Cercariaea* are rather sluggish and creep around slowly, they are extremely variable in form as shown in Pl. XXXII, figs. 2—3, Pl. XXXIII, fig. 1. They represent the same animal drawn in the course of five minutes.

It has often been alleged that this as well as other tailless Cercariae encyst in the same snail and remain there. This, however, is not correct, as Loos (1894, p. 32) has observed them creeping on the bottom; with regard to this species Wunder (1924 a, p. 333) has made a series of excellent observations which I can only confirm on all points.

If *Bithynia tentaculata* infected with *Cercariaeum paludina impurae* is kept in vessels, it will be seen that the antennae especially at their tip carry small white fluffs which, observed under a lens, present themselves as *Cercariaea* (Pl. XXXIII, fig. 2). When more closely studied it will be seen that they creep out of the spiracle and pass over the head of the snail whereupon they proceed to the tentacles which in their whole length may be fluffy; more than fifty *Cercariaea* may be found on each tentacle. When the antennae come into contact with other snails, the *Cercariaea* jump on to them and enter the snail, afterwards encysting there. The *Cercariaea* are always fastened by the ventral sucker, the fore- and the hindpart of the body is elevated. The animals stretch out the forepart of the body in all directions. When the snail draws in the antennae, the *Cercariaea* follow, and when they are again extended they are still present and in the same number. I have had snails with infected antennae for weeks in my vessels, but I suppose that the old *Cercariaea* enter the snail to encyst there and that those I have observed during all that time are new arrivals. Like Wunder, I have never seen *Cercariaea* creeping freely upon the bottom of the vessels. As I have had the macrocercous Cercariae around the mantle borders of *Sphaerium* in one glass, and at the same time the *Cercariaea* on the tentacles of *Bithynia* in another, and observations were made on both simultaneously, it was quite natural to surmise that the constantly moving tails of the *Macrocercariae* played the same role for the body as the *Bithynia*-tentacle which was extended now in one now in another direction for the *Cercariaeum*.

Like Wunder (1924 a, p. 335) I have seen that the cysts are mainly found around the rectum, the Rediae with the *Cercariaea* in the liver. —

Cercariaeum paludinae impurae is common in our freshwaters. It was first found on 21/VI 31 at Langesø near Hillerød. It was there that I first saw the fluffy antennae at a time when Wunder's observations were quite unknown to me. It was present here to the number of four out of ten; later on it was found at Donse on 9/VII to the number of 42. At the border of one of our largest lakes, Arresø, 12 *Bithynia* out of 15 had *Cercariaea* on their antennae.

On 17/V 32 new material was taken from Langesø and infected. *Bithynia* isolated. The *Bithynia* moved but slowly, the *Cercariaea* disappeared from the antennae. On

18/VI a *Bithynia* was dissected and cysts were now found, especially round the heart. On 30/V new material was taken from Langesø. Of 35 specimens only one had Rediae; the remaining 34 had no Rediae but cysts were found in 33. The number of cysts was commonly about 30 but might amount to 50. Only exceptionally was the number 3—4. Only one specimen was quite free.

Side by side with the *Bithynia* lived *Physa fontinalis*. Ten were dissected. All contained 10—40 encysted *Cercariaea*, but not a single one Rediae. This would seem to show, as Wunder too maintains, that the encystation may also take place in other snails.

The place of the cysts was always the same, near the rectum or round the heart, only rarely in the liver and then always in the lower part.

Bithynia tentaculata infected with *Cercariaeum* has also been found in other localities; in Teglgaardsø (on 11/IX 31) near Hillerød, at the borders of Tjustrup Lake on 6/VIII 31, and in two specimens out of 200 at a depth of 3—4 m in Esrom Lake on 28/IX 31. In none of these cases were any Cercariaea observed on the antennae of the snail; the liver mainly contained not quite ripe *Cercariaea*. The specimens from Esrom Lake were full-grown and of a remarkably large size. It is perhaps questionable whether it is correct to refer all *Cercariaea* from *Bithynia tentaculata* to a single species. Petersen (1931, p. 22) has described a form *Cercariaeum* 2 from *Bithynia tentaculata*, but description and drawing are so incomplete that most probably it will not be possible to identify it. Provisionally, it only seems to deviate from *C. paludinae impurae* by having a smooth cuticula without spines.

How the species *Cercariaeum paludinae impurae* (Fil.) is to be interpreted is a matter of doubt. Filippi distinguished two, the one with a stylet (*armata*) the other without it (*inermis*). The former according to Dubois (1929, p. 100) has 36 flame-cells, a tubular vesicle and two testes, the inermis form 64 flame-cells, a small pear-shaped vesicle and only one testis. From this description there can be no doubt that we are here concerned with two species. Loos (1894, p. 32) regards the two forms as identical and calls it *Cercaria Distomi perlati*. All the specimens which I have found in *Bithynia* possess a tubular vesicle but I confess that I have not been able to convince myself that there is a stylet. Nevertheless, I refer them to *C. paludinae impuriae, forma armata* Fil. What forma *inermis* is, is a matter of doubt. In *L. auricularia* I have found a form which on all other essential points resembles *C. paludinae impura* but like the *inermis* form has only one testicle and a small vesicle. We will return to this form later on.

Cercariaeum No. 1. Petersen. Host: *Paludina vivipara.*

Pl. XXXIV, figs. 2—5.

The body is covered with remarkably stout spines, strongest and most numerous on the forepart of the body; the spines are not acute but have a remarkable bluntly rounded apex. The dimensions are:

Cercariae:

	Living
Length of body	990
Breadth of body	520
Diameter of oral sucker	130
Diameter of ventral sucker	280

Rediae:

Length	145
Breadth	100

The ventral sucker is much larger than the oral one; if concentric circles of spines are present, they are at all events very small. There is a very short prepharynx and a rather small pharynx; the oesophagus is extremely short; the intestinal coeca begin almost directly behind the pharynx; the ventral sucker lies almost in the middle line of the animal and the intestinal coeca divide long before the ventral sucker. They are very broad and reach almost halfway between the posterior border of the ventral sucker and the posterior end of the animal. A stylet at the anterior border of the oral sucker has not been observed. The whole part around the pharynx down to the ventral sucker is filled with two large grapeformed glands consisting of very small cells with granular contents and small nuclei. The excretory system consists of a tripartite excretory bladder, the unpaired part being the largest and opening upon the apex of the animal by a rather large pore. The paired parts are almost globular and give rise to the two main trunks which do not divide before the middle of the ventral sucker; the main trunk passes forward to the oral one; here it makes a loop and passes backward, reaching the central part of the ventral sucker. I have been unable to follow it any farther from the same; point arises another branch which passes forward and sends fine branches around the oral sucker; from the main trunks there issue fine branches ending in vibratile tags, at least three, but their number has not been counted with certainty. Owing to the remarkably thick, wrinkled and spiny consistence of the skin and because of their almost yellow colour the animals are very opaque. The curious thing is that the returning branches of the excretory main trunks in their interior carry about 15 flames which are very conspicuous and localised on quite distinct, and as far as I can see, constant spots. I have never seen this in any of the other *Cercariaeum* species described. Between the ends of the two intestinal coeca lies the relatively small ovarium and behind them the two testes. The Cercariaea were very sluggish, subject to variation in form, but never found outside the snails (Pl. XXXIV, fig. 3 a—d). The large ventral sucker made the animal always very broad in the central part of the body. — The interesting form was only found in three of about a hundred *Paludina vivipara;* only on 2/II 32 and again on 17/IV; in each snail only 5 to 7 were found, and several very young forms. The strange thing was that they were only found in small halfgrown specimens, not in the large ones, and furthermore that they were always lying free in the liver. They were extremely sluggish. I saw no Sporocyst or Redia to which this peculiar form could be referred with certainty; the Cercariaea were always enveloped in a whole mantle of spermatozoa.

It was remarkable, however, that the liver was covered with small Sporocysts, hyaline but with a very thick paletot (Pl. XXXIV, figs. 4—5). They contained great numbers of very small granules. They were found in two of the snails, and in both very small Cercariaea, so small that it might be supposed that they had shortly before left the Sporocysts; in the above-named Sporocysts were never found young Cercariaea, and to this very moment I do not know if these presumed bodies belong as Sporocysts to the *Cercariaeum*. Lack of material prevented a more thorough study. The *Cercariaeum* is a highly peculiar form, by the structure of the bladder it belongs to the *squamosum* group of Dubois, but by the two testicules to the *mutabile* or *helveticum* group. It seems to break the division of Dubois.

Petersen (1931, p. 22) describes from male *Paludina*, but only from old animals, a peculiar form with a cuticula covered with "kleinen Höckern", a ventral sucker almost twice as large as the oral one, with the intestinal coeca diverging a long way before the oral sucker, and with a tripartite excretory bladder, just as I have seen it. It seems highly probable that we are here concerned with the same species. The figures seem to show that he too has found vibratile flames in the excretory vessels. His description deviates from mine; he alleges that there is only one common "anlage" for the sexual organs and that this is formed like a clover leaf.

My species has only been found in February and April in small ponds near Hellebæk, North-Sealand.

Cercariaeum limnaeae obscurae Ercolani. Host: *Limnaea ovata*.

Pl. XXXIII, fig. 3, Pl. XXXIV, fig. 1.

I think that I have only once seen this species. It was found in one of 10 specimens of *Limnaea ovata* in the Torkeris Pond near Hillerød (15/V 31). The Rediae contained 4—6 perhaps not quite ripe Cercariaea which were only spinose in the forepart of the body; the bladder was tripartite with the unpaired part small and globular. The material was not large enough to allow of a more thorough examination.

Cercariaeum gibba n. sp. Host: *Valvata piscinalis*.

Pl. XXXIII, figs. 4—5, Pl. XXXIV, fig. 6.

The body is extremely broad and clumsy; the cuticula is very thick, slightly spinose and the whole animal very opaque.

The dimensions are:

Cercariae:

	Living
Length of body	375
Breadth of body	250
Diameter of oral sucker	60
Diameter of pharynx	50
Diameter of ventral sucker	130

Rediae:

Length	400
Breadth	115
Oral sucker	30

The oral sucker is large; anteriorly are found six small taps; a stylet has not been observed; the ventral sucker, which is extremely large, gives the whole animal its form; the suckers are spineless. There is a very short prepharynx, and a very large globular pharynx; the oesophagus is remarkably slender and often bent in a loop; the two intestinal coeca, when the animal is extended, diverge almost halfway between pharynx and ventral sucker (Pl. XXXIV, fig. 6); they are broad and run downwards beside the bladder. There are 2 × 3 elongate pear-shaped glands which give off long ducts to the oral sucker (Pl. XXXIV, fig. 6). The excretory bladder is highly peculiar; it has thick walls, is almost triangular of form, and contains numerous globular refracting bodies; behind it is a short tube ending at the apex of the animal. On pressure the refracting bodies pass through the tube and remain in a little heap behind the animal. From the two anterior corners of the bladder issue the excretory tubes which I have not been able to study more thoroughly; as far as I have been able to see, they are constructed in accordance with the tubes in *C. paludinae impurae.*

There is a rather large ovary (Pl. XXXIV, fig. 6). There is at any rate only one testis, but it has not been seen with certainty. This very peculiar form was found in only a single *Valvata piscinalis var. antiqua* out of 50 specimens (Furesø 22/IX 31). Only three individuals were found creeping in the liver. Some few Rediae were found, and these contained tailless Cercariae. The pharynx was very small, the intestine short; there were no locomotoric appendages.

Cercariaeum crassa n. sp. Host: *Pisidium amnicum.*

Pl. XXXIII, fig. 6, Pl. XXXIV, figs. 8—9.

The body is covered with fine spines, best developed in the forepart. The dimensions are:

Cercariae:

	Living
Length of body	840
Breadth of body	290

	Living
Diameter of oral sucker	125
Diameter of ventral sucker	130

Rediae:

Length	2400
Breadth	360
Oral sucker	130

The oral and ventral sucker are nearly the same size, the ventral sucker lies almost in the middle line of the animal. No stylet in the frontal border of the oral sucker and no circles of small spines have been observed. The prepharynx is very short; the pharynx globular and the oesophagus long, commonly strongly bent; the intestinal coeca diverge immediately before the ventral sucker; they almost reach the posterior end of the animal. Most of the space between the oral and ventral suckers is filled with clusters of small cells with a granular content and small nuclei. There is a large elliptical contractile bladder containing numerous globular bodies which become displaced, when the animal is pressed. It ends with a short tube which opens posteriorly. From the anterior border of the bladder issue the two main excretory tubes running forwards. Owing to the opacity of the animal only little of the tubes has been observed. As far as I can see, they divide near the posterior edge of the ventral sucker, giving off a branch anteriorly and one posteriorly; just where they divide is seen a ball formed of many loops. The genital organs could not be made out, the specimens not being quite ripe.

When pressed the animals have the normal *Cercariaeum* form but without pressure the animals were of an extremely clumsy form with the ventral sucker placed on a foot-like part of the ventral side (Pl. XXXIV, fig. 9).

The Cercariaea were developed in large Rediae (Pl. XXXIV, fig. 8) which had a small pharynx and very small intestine. The Rediae contained very many Cercariaea, often 15—20; no posterior locomotoric appendages were present.

The species was found in a *Pisidium amnicum* found on 20/XI 31 in the Furesø. It came from a depth of 4—6 m. Only a single specimen was found, and this contained many Rediae on the gills but no free *Cercariaea*.

Petersen (1931, p. 22) has described a *Cercariaeum No. 3* from a *Sphaerium corneum*. Otherwise *Cercariaea* have not hitherto been found in freshwater mussels. The description is very insufficient and his and my own observations can only serve to show that our *Sphaerium* and *Pisidium* species really contain *Cercariaeum* stages. A more thorough study of these forms is much needed.

Cercariaeum limnaeae auriculariae Fil. Host: *Limnaea auricularia.*

Pl. XXXIII, fig. 7, Pl. XXXIV, fig. 7. Microphotos XXXVI, figs. 3—4.

The body is covered with fine spines; they are more numerous in the forepart. The measurements are:

Cercariae:

	Living
Length of body	580
Breadth of body	230
Diameter of oral sucker	95
Diameter of ventral sucker	130

Rediae:

Length	4200
Breadth	900

The ventral sucker is larger than the oral one.

I have seen no stylet at the anterior edge of the oral sucker. The prepharynx is short; the pharynx globular, the oesophagus long and commonly twisted. The two intestinal coeca branch off directly round the ventral sucker and reach halfway between it and the posterior end of the animal. The ventral sucker lies almost in the middle. The whole space between the two suckers is filled with clusters of small cells with a granular content and small nuclei. There is a small excretory bladder which opens posteriorly and anteriorly gives off two excretory tubes. These tubes pass forward in many loops, almost reaching the oral sucker. Then they pass backward again, and near the anterior border of the ventral sucker they divide, sending one branch anteriorly and one posteriorly. From these branches issue branches of the third order, and these carry the flame cells. There is a large testis; before it a small ovarium. Behind the ventral sucker and laterally lie the loops of the uterus and cirrus pouch, equipped with internal spines. This peculiar form develops in Rediae (Pl. XXXIV, fig. 7) of a reddish colour, they protrude from the liver which looks as if it was covered with thick spines; the pharynx is extremely small, and so is the intestine. There are no posterior locomotoric appendages. The Redia contains many Cercariaea, often 20—30. Most of the Rediae have a blunt forepart and a more attenuated hindpart which may assume the character of a tail or thread; it is commonly by this end that they are fastened to the liver; the forepart protrudes freely into the body cavity.

This peculiar form was found on 25/VI 32 in *Limnaea auricularia* in Hulsø, a little lake lying near Furesø. Of 25 specimens only a single one contained the *Cercariaeum*. On 12/VII, when new material was desired, it was found that all the old large snails to which the above-named 25 belonged had died; only very young snails were present and in them I only once saw some Rediae on the intestine; it could not be decided if these Rediae belonged to this species. In June 1933 40 large specimens of *L. auricularia* were examined but neither Rediae nor Cercariae were found in a single one of them. The above-named snail from 25/VI was immediately after arrival in the laboratory separated from the others as suspect. *Cercariaea* were not observed, but round the borders of the mantle were seen yellowish white tumor-like swellings.

When pricked with a needle, the above-named Rediae poured out; curiously enough, *Cercariaea* were never found free in the tumors or in the liver.

Sewell (1922, p. 171) says that in specimens of *Lecythoconcha lecythis* and *Vivipara oxytropis* he has found gelatinous yellow cysts in the thick edge of the mantle. The cysts measured $1^1/_2$—2 mm. in length and about 1 mm. in breadth, and each communicated with the external surface of the mantle, that is, the surface in apposition with the shell, "through a small pore". The cysts contained immature *Leucochloridium* measuring 2—3 mm. in length.

What Sewell has seen is of course not identical with my observation; the tumors are not cysts, and they have no communication with the surface. They do not contain free *Cercariaea* but Rediae. Nevertheless, with *Leucochloridium* in mind, I was much interested in the observation. The tumors filled with *Cercariaea* carrying Rediae were found at the borders of the mantle, others were found on the head near the antennae. The Rediae with their exceedingly small pharynx and almost no intestine give the impression of being Sporocysts. The place of the Rediae as well as their form like sacks packed with Cercariaea stages caused that the thought was directed upon *Leucochloridium;* it was as if this observation showed the way to an understanding of how the development of this incredible organism has taken place.

I refer this species to *Cercariaeum limnaeae auriculariae* Fil. It is said to be closely related to *C. paludinae impurae* but to differ from it in the development in Sporocysts. Only a closer examination will reveal the character of the sacks as Rediae; here as often it is rather problematic whether the parthenitae should be designated as Sporocysts or as Rediae. It differs considerably from it, however, in the structure of the Rediae. The pharynx and intestine are larger and the number of Cercariae in the Redia much smaller (5—7) in *C. paludinae impurae* than in *C. limnaeae auriculariae*.

Leucochloridium paradoxum.

Pl. XXXII, figs. 7—8.

With regard to this form it will suffice to refer the reader to Part I of this work.

Chapter XI.

The degree of infection of the Danish Mollusc fauna.

Localities.

1 Akvarie Pond = Lange Pond.
2 Amager Pond.
3 Ande Pond.
4 Arresø.
5 Bagsværd Lake.
6 Bromme Lake.
7 Castle Park, Frederiksborg.
8 Clausens brick factory Pond.
9 Donse Pond.
10 Esrom Lake.

11 Emdrup Pond.
12 Fortun Pond.
13 Funke Pond.
14 Furesø.
15 Fønstrup Pond.
16 Grønholt Ponds.
17 Grønnegade Pond.
18 Hellebæk Pond.
19 Hørsholm Pond.
20 Hulsø.
21 Hørsholm Springpond.
22 Indelukket canals, Hillerød.
23 Kehhusbakke Pond.
24 Langesø Pond.
25 Lange Pond = Akvarie Pond.
26 Lynge Pond.
27 The moor. Hillerød.
28 Næsbybro Pond.
29 Ramløse Rivulet.
30 Regnstrup Pond.
31 Steenstrup Pond.
32 Strødam Pond.
33 The rivulet Susaa.
34 Teglgaard Pond.
35 Torkeris Pond.
36 Tjustrup Lake.
37 Tuel Lake.
38 Vixø Moor.
39 The rivulet of Værebro.

In the above named list I have given the names of all localities which have been fairly often or regularily explored. They are given in alphabetical order. All the localities are in Seeland; those with italiced are in the middle of Seeland near Tjustrup and Sorø Lake, where our summerlaboratory is; the others are in the neighbourhood of Hillerød in most cases inside a radius of ca. 30 kilom.

The Strødam ponds have been of special importance for the investigations. The are situated in the Strødam Reservation about 3 km from Hillerød. This vas erected by the owner, Mr. Axel Jarl, as a reservation for the Sealandic fauna and flora and as a place where observers could carry on their studies undisturbed. At a time when so many localities, more especially small ponds, are either being destroyed or utilised for other purposes, it is of the utmost importance that there should be a locality whose flora and fauna are protected and accessible to observers who wish to carry on their investigations for a period of more than one year.

The explored lakes are Arresø, Esrom Lake, Tjustrup Lake and Furesø.

Smaller lakes are Bagsværd Lakes, Bromme Lake, Frederiksborg castle Lake, Hulsø and Tuel Lake.

All the other waters are only ponds, in very many cases very small ponds, with a depth of below 1 m. and commonly packed with vegetation.

Molluscs	Locality	Number of snails dissected		Trematoda
Sphaerium corneum	3, 10, 13, 14, 18, 24, 32, 35	411	Macroc. —	C. Pagenstecheri Ssin. C. vitellilobae = macrocerca Fil.
Pisidium amnicum	14.................	1	Cercariaeum	C. crassa.
Anodonta	14, 21..............	110	Furcoc.	C. Bucephalus polymorphus.
Dreyssensia polymorpha	14, 10..............	100	0	
Neritina fluviatilis	4, 10, 14, 36, 37......	190	0	

Molluscs	Locality	Number of snails dissected	Trematoda	
Paludina vivipara	18, 36	157	Echinos.	C. echinatoides Fil.
			Xiphidioc.	C. cellulosae Loos.
			Cercariaeum	C. No. 1. Petersen n. sp.
Valvata piscinalis	10, 14, 36	350	Echinos.	C. abyssicola n. sp.
			Furcoc.	C. cristata La Val.
			—	C. longiremis n. sp.
			Cercariaeum	C. gibba n. sp.
Bithynia tentaculata	5, 6, 7, 9, 10, 14, 15, 18, 19, 20, 24, 25, 27, 28, 29, 32, 33, 35, 36, 38	1785	Monost.	C. imbricata Loos.
			Gymnoc.	C. tuberculata Fil.
			—	C. papillosa Fil.
			—	C. helvetica XIX Dubois.
			—	C. obscura (Dubois).
			—	C. grandis n. sp.
			—	C. n. sp.
			—	C. lophocerca Fil.
			Xiphidioc.	C. vesiculosa Dies.
			—	C. pusilla Loos.
			—	C. cordiformis n. sp.
			—	C. nodulosa v. Linst.
			—	C. virgula Fil.
			—	C. helvetica IX Dubois.
			Furcoc.	C. vivax Sonsino.
			—	C. cristata n. sp.
			—	C. No. 4. Petersen.
			Microc.	C. micrura Fil.
			Cercariaeum	C. paludinae impurae Fil.
Bithynia Leachii	10	100	0.	
Limnaea stagnalis	3, 5, 6, 8, 9, 11, 12, 14, 19, 20, 21, 24, 26, 27, 31, 32, 34, 35, 36, 37, 38	714	Monost.	C. monostomi v. Linst.
			Echinos.	C. echinata Sieb.
			Xiphidioc.	C. laticauda n. sp.
			—	C. Haplometrae cylindricae Zed.
			Furcoc.	C. lophocerca La Val.
			—	C. ocellata La Val.
			—	C. C. Szidat.
			—	C. Strigeae tardae Math.
Limnaea palustris	4, 5, 6, 12, 14, 22, 24, 36, 37	193	Echinos.	C. echinostomi Dubois.
			Furcoc.	C. helvetica XXXI Dubois.
			—	C. A. Szidat.
Limnaea truncatula	5 localities; vide p. 30.	910	Gymnost.	C. Fasciolae hepaticae Thomas.
Limnaea ovata	2, 5, 6, 7, 9, 14, 18, 19, 20, 22, 25, 32, 34, 35, 36	580	Monost.	C. monostomi v. Linst.
			Echinost.	C. Hypodereae conoideae Math.
			Xiphidioc.	C. Limnaeae ovatae v. Linst.

Molluscs	Locality	Number of snails dissected	Trematoda	
			Furcoc.	C. cristata La Val.
			—	C. ocellata La Val.
				C. 1. Petersen.
			Cercariaeum	C. Limnaeae obscurae Ercol.
Limnaea auricularia....	5, 11, 14, 20, 33, 36...	324	Echinost.	C. affinis n. sp.
			Furcoc.	C. letifera Fuhrm.
			—	C. C. Szidat.
			—	C. 1. Petersen.
			Cercariaeum	Limnaeae auriculariea Fil.
Physa fontinalis	4, 10, 14, 24, 27, 28, 29	168	Furcoc.	C. 1. Petersen.
Planorbis corneus	1, 5, 6, 9, 14, 16, 19, 20, 23, 25, 27, 29, 31, 32, 33, 34, 35, 36	850	Monost.	C. ephemera Nitzsch.
			Echinost.	C. spinifera La Val.
			Xiphidioc.	C. gracilis n. sp.
			Cystoc.	C. splendens Szidat.
			Furcoc.	C. Bilharziellae polonicae Kow.
			—	C. Frederiksborgensis n. sp.
				C. linearis n. sp.
Planorbis umbilicatus ..	3, 5, 14, 15, 17, 19, 27, 30, 36	341	Amphist.	C. diplocotyleae Fil.
			Echinost.	C. echinoparyphii recurvati Math.
			Furcoc.	C. F_1 Harper.
Planorbis contortus.....	16.................	35	0.	
Planorbis carinatus.....	27.................	25	0.	
Planorbis vortex........	14, 27, 32, 38........	183	Monost.	C. ephemera Nitzsch.
Planorbis albus.........	7..................	80	Xiphidioc.	C. prima Ssn.
Planorbis nitidus.......	17, 35.............	200	0.	
Acroloxus lacustris	....	50	0.	

A little more than 7800 molluscs have been dissected.

The number of now described Danish Cercariae are 61. Of these species Steenstrup in his famous work found *C. echinata* v. Sieb. and *C. armata* v. Sieb. The other may be regarded as new to our fauna.

It may be added that O. F. Müller was the first to describe and figure two Cercariae *C. inquieta* and *C. lemnae:* 1788—1806, vol. IV, p. 121—122, Pl. 18, figs. 3—12; they cannot be identified.

The above-mentioned list gives material for the estimation of the degree of infection of the Danish Molluscs.

The first column gives the Molluscs which have been dissected; the second the number of the locality mentioned on p. 174; the third the number of Molluscs dissected; and the last column the name of the Cercaria. Referring the reader especially to p. 186, the list gives no cause for many remarks. It will be seen that only few of the small *Planorbis* species have been dissected; a more elaborate investigation on this point would be desirable. It seems to me rather remarkable that *Anodonta, Dreyssensia,* and *Neritina* have given almost no Cercariae; the *Bucephalus* was found in a single *Anodonta* specimen which had lived for months in one of our aquaria. The result is surely not in accordance with the real facts, and this is likewise the case with the infectivity of *Limnaea truncatula*. Even if the number of *Bithynia tentaculata* (1785) dissected is much larger than that of all the other snails, I am under the impression that of all our Mollusc species this very snail harbours most species of Trematoda. 19 species have been found in it.

Of *Limnaea stagnalis* and *Planorbis corneus* almost the same number has been dissected; of the former 714, of the latter 850; the former was infected by 8 species, the last-named by 7. The remarkable thing is that they have not two species in common. When it is kept in mind that the two species very often lie side by side and often in enormous numbers, this shows, as has been often pointed out, either that host preference must be a rather indisputable fact with regard to the Miracidia, or that the parthenitae can only develop in quite distinct snails.

Chapter XII.

The Trematode Fauna in 12 Localities in the Years 1931—1932.

In order to study the Trematode fauna in localities differing from each other in my area of exploration I selected 12 localities, viz. 3 lakes, 3 smaller lakes, and 6 ponds, some of which were very small. These latter 6 ponds are covered with vegetation during the summer months. The localities are as follows:

Lakes:	Furesø.
	Esrom Lake.
	Tjustrup Lake.
Smaller lakes:	Bagsværd Lake.
	Bromme Lake.
	Hulsø.
Ponds:	Strødam Pond.
	Donse Pond.
	The moor, Hillerød.
	Hellebæk.
	Torkeris Pond.
	The ditch near the border of Furesø (Frederiksdal).

Furesø.

			Infected snails	Dissected snails
1	Monost. C. ephemera	Planorbis corneus	4	20
2	Gymnoc. C. papillosa	Bithynia tentaculata	20	200
3	— C. obscura	Bithynia tentaculata	7	120
4	Echinost. C. affinis	Limnaea auricularia	17	137
5	— C. echinoparyphii recurvati	Planorbis umbilicatus	7	40
6	Xiphidioc. C. nodulosa	Bithynia tentaculata	1	290
7	Cystoc. C. splendens	Planctonic		
8	Furcoc. C. cristata	Valvata piscinalis	1	50
9	Furcoc. C. Szidat	Limnaea stagnalis	1	1
9	— C. Szidat	Limnaea auricularia	1	140
10	— C. 1 Petersen	Limnaea auricularia	1	137
11	— A. Szidat	Limnaea palustris	7	25
12	— C. 4 Petersen	Bithynia tentaculata	3	250
13	— Tetracotyle	Bithynia tentaculata	4	290
14	Microc. C. micrura	Bithynia tentaculata	5	290
15	Cercariaeum C. paludinae impurae	Bithynia tentaculata	1	190
16	— gibba	Valvata piscinalis	1	150
17	— crassa	Pisidium amnicum	1	1

Esrom Lake.

1	Monost. C. imbricata	Bithynia tentaculata	8	357
2	Gymnoc. C. papillosa	Bithynia tentaculata	2	357
3	Echinost. C. affinis	Limnaea auricularia	9	20
4	Xiphidioc. C. nodulosa	Bithynia tentaculata	3	357
5	Furcoc. C. 1 Petersen	Limnaea auricularia	9	20
5	— C. 1 Petersen	Physa fontinalis	5	50
6	— Tetracotyle	Limnaea auricularia	2	20
7	Microc. C. micrura	Bithynia tentaculata	5	357
8	Cercariaeum C. paludinae impurae	Bithynia tentaculata	2	357

Tjustrup Lake.

1	Monost. C. ephemera	Planorbis corneus	1	7
2	— C. monostomi	Limnaea stagnalis	1	7
3	Gymnoc. C. lophocerca	Bithynia tentaculata	1	4
4	Echinost. C. abyssicola	Valvata piscinalis	3	80
5	— C. echinostomi	Limnaea palustris	2	10
6	— C. affinis	Limnaea auricularia	1	10
7	— C. spinifera	Planorbis corneus	1	1
8	Xiphidioc. C. vesiculosa	Bithynia tentaculata	5	30
9	Furcoc. C. letifera	Limnaea auricularia	1	1
10	— C. 1 Petersen	Limnaea auricularia	1	1
10	— C. 1 Petersen	Limnaea ovata	1	1
11	— Helvetica XXXI	Limnaea palustris	1	10
12	Cercariaeum C. longiremis	Valvata piscinalis	13	110
13	— C. paludinae impurae	Bithynia tentaculata	2	91

Bagsværd Lake.

			Infected snails	Dissected snails
1	Monost. C. ephemera	Planorbis corneus	3	6
2	Gymnoc. C. tuberculata	Bithynia tentaculata	1	8
3	Echinost. C. Hypodereae conoideae	Limnaea ovata	1	1
4	— C. echinostomi	Limnaea palustris	1	4
5	Furcoc. C. C. Szidat	Limnaea stagnalis	1	8
6	— C. strigeae tardae	Limnaea stagnalis	4	23
7	— Tetracotyle	Limnaea stagnalis	15	23

Bromme Lake.

1	Monost. C. imbricata	Bithynia tentaculata	17	80
2	Gymnoc. C. tuberculata	Bithynia tentaculata	16	80
3	Echinost. C. echinostomi	Limnaea palustris	1	20
4	Xiphidioc. C. Limnaeae ovatae	Limnaea ovata	1	20
5	— C. Haplometrae cylindricae	Limnaea palustris	2	80
5	— C. Haplometrae cylindricae	Limnaea stagnalis	2	13
6	— C. gracilis	Planorbis corneus	8	15
7	— C. nodulosa	Bithynia tentaculata	15	80
8	Furcoc. C. helvetica XXXI Dubois	Limnaea palustris	2	2

Hulsø.

1	Monost. C. ephemera	Planorbis corneus	1	8
2	Gymnoc. C. tuberculata	Bithynia tentaculata	1	15
3	Echinost. C. echinata	Limnaea stagnalis	1	24
4	Xiphidioc. C. nodulosa	Bithynia tentaculata	1	15
5	Furcoc. C. cristata	Limnaea stagnalis	2	24
6	Cercariaeum Limnaeae auriculariae n. sp.	Limnaea auricularia	1	190
7	— paludinae impurae	Bithynia tentaculata	1	8

Strødam Pond.

1	Monost. C. ephemera	Planorbis corneus	1	55
2	Gymnoc. C. tuberculata	Bithynia tentaculata	4	120
3	Echinost. C. echinata	Limnaea stagnalis	3	12
4	— C. spinifera	Planorbis corneus	5	5
5	Xiphidioc. C. virgula	Bithynia tentaculata	17	120
6	— C. cordiformis	Bithynia tentaculata	7	25
7	— C. Limnaeae ovatae	Limnaea ovata	33	45
8	— C. laticauda	Limnaea stagnalis	1	220
9	Furcoc. C. strigeae tardae	Limnaea stagnalis	2	127
10	— Tetracotyle	Limnaea stagnalis	103	127
11	— Tetracotyle	Limnaea ovata	5	45
12	— Tetracotyle	Planorbis corneus	2	55

Donse Pond.

1	Monost. C. ephemera	Planorbis corneus	2	100
2	— C. imbricata	Bithynia tentaculata	1	30
3	Gymnoc. C. tuberculata	Bithynia tentaculata	5	42

			Infected snails	Dissected snails
4	Echinost. C. echinata	Limnaea stagnalis	5	38
5	— C. Hypodereae conoideae	Limnaea ovata	3	10
6	— C. spinifera	Planorbis corneus	3	100
7	Xiphidioc. C. Haplometrae cylindricae	Limnaea stagnalis	2	38
8	— C. gracilis	Planorbis corneus	11	100
9	— C. cordiformis	Bithynia tentaculata	4	42
10	Furcoc. C. strigeae tardae	Limnaea stagnalis	3	38
11	— Tetracotyle	Limnaea stagnalis	35	38
12	Cercariaeum C. paludinae impurae	Bithynia tentaculata	1	30

The moor, Hillerød.

1	Monost. C. ephemera	Planorbis corneus	18	190
2	— C. imbricata	Bithynia tentaculata	2	25
3	Echinost. C. spinifera	Planorbis cornens	11	190
4	— C. echinoparyphii recurvati	Planorbis umbilicatus	1	30
5	Xiphidioc. C. gracilis	Planorbis corneus	142	190
6	— C. cordiformis	Bithynia tentaculata	4	25
7	Cercariaeum paludinae impurae	Bithynia tentaculata	2	25

Hellebæk Pond.

1	Monost. C. imbricata	Bithynia tentaculata	2	208
2	Gymnoc. C. papillosa	Bithynia tentaculata	2	208
3	Echinost. C. echinatoides	Paludina vivipara. As cysts	74	78
4	Xiphidioc. C. pusilla	Bithynia tentaculata	5	35
5	— C. cordiformis	Bithynia tentaculata	5	100
6	— C. nodulosa	Bithynia tentaculata	25	100
7	— C. cellulosae	Paludina vivipara	1	200
8	Furcoc. C. sp.	Bithynia tentaculata	1	75
9	Cercariaeum C. No. 1. Petersen	Paludina vivipara	7	78

Torkeris Pond.

1	Monost. C. ephemera	Planorbis corneus	58	220
2	Echinost. C. echinata	Limnaea stagnalis	10	93
3	— C. spinifera	Planorbis corneus	220	220
4	Xiphidioc. C. Haplometrae cylindricae	Limnaea stagnalis	18	93
5	Macroc. C. vitellilobae	Sphaerium corneum	1	25
6	Furcoc. C. Bilharziellae polonicae	Planorbis corneus	1	10
7	— C. linearis	Planorbis corneus	1	220
8	— Tetracotyle	Planorbis corneus	4	220
9	— Tetracotyle	Limnaea stagnalis	4	93
10	Cercariaeum C. Limnaeae obscurae	Limnaea ovata	1	55

The ditch near the border of Furesø, Frederiksdal.

1	Monost. C. ephemera	Planorbis corneus	4	30
2	— C. monostomi	Limnaea palustris	1	30
3	Echinost. C. echinata	Limnaea stagnalis	1	10

			Infected snails	Dissected snails
4	Echinost. C. echinostomi	Limnaea palustris	9	30
5	— C. Echinoparyphii recurvati	Planorbis umbilicatus	7	40
6	Xiphidioc. C. sp. Only sporocyst	Limnaea palustris	5	30
7	Furcoc. C. A. Szidat	Limnaea palustris	7	30
8	— C. F_1 Harper	Planorbis umbilicatus	8	40
9	— Tetracotyle	Limnaea palustris	30	30
10	— Tetracotyle	Planorbis corneus	2	30

The first column figures gives the number of infected snails, the last the number of dissected snails. The localities were visited 10—15 times at all seasons of the year in 1931—1932. From every excursion the number of dissected snails and the number of infected ones have been noted. Tables of these have been worked out and it was my intention that this material too should have been printed. However, as I cannot see that the results answer to the efforts, I have not insisted upon the publication of this part of the material.

It would seem that only the following rather meagre results can be extracted from the material:

1. There appears not to be any special Trematode fauna limited to the three above-named categories: lakes, smaller lakes, and ponds, nor any to strongly eutrophic ponds or those of a more dystrophic nature (Hulsø).

As the Prosobranchiata in the lakes preponderate over Pulmonata at depths of more than 5 m. and the two groups of snails have each their special Trematode fauna, the Trematoda parasitising Prosobranchiata are perhaps prevalent in the lakes; since, however, *Bithynia tentaculata* is very common even in smaller ponds, most of this group will also be found there.

2. It would seem that the Furcocercariae preponderate in the lakes. As they are plancton organisms, this is only what might be expected, but those parasitising *Planorbis corneus* and *Limnaea stagnalis* are also or mainly found in ponds. Species which use *Limnaea stagnalis* in ponds use its substitute *L. auricularia* in lakes.

3. With regard to the percentage of infected snails it would seem that it is almost always much larger in ponds than in lakes; more than 3—4 per cent is rare in lakes; in ponds the percentage very often exceeds 50 or may even rise to almost 100. This is due to the enormous aggregation of snails in the vegetation covering the surface of ponds with floating leaves (*Potamogeton, Nymphaeaceae, Hydrocharis*).

4. As already mentioned in the introduction, I had hoped if the investigations were carried on during two consecutive years that I should find the same Trematode fauna in the same place in the two years and that in this way I should be able to correct and complete my observations from the first year. This, however, was hardly ever the case. Forms from the first year were only rarely present in the second, and new species appeared which I had not found in the first year.

There was, however, one phenomenon which struck me again and again and which was found in many localities.

If a species of snail in a pond or small lake had been strongly infected one year, the snails had almost totally disappeared the next. If we remember the extremely corroded shells, the fact that the hermaphroditic gland was destroyed by the parasites, and that egg masses could not be found in the pond, there can be no doubt that the parasites have killed the whole stock of snails. Combined with this there was another result. In very many cases the strongly corroded snails were also very large specimens. First I supposed that these large specimens were very old most probably several years old. This would be in accordance with the current supposition that e. g. the large Limnaea species, *L. ovata*, *L. auricularia* and *L. stagnalis* have a lifetime of two years or perhaps even more.

It may be so in aquaria, and there may be localities also in my country where they attain that age; having now visited several hundred localities, and having gathered the snails at regular intervals and studied them in autumn, winter and early spring, I have received the impression that their age in very many localities is not much more than one year, and that two hibernations are the exception and not the rule.

Of course my thoughts always centred round the Cercaria fauna of the snails, but this by no means prevented me from slowly, through a number of years, gathering a number of impressions with regard to the biology of our snails which were not in accordance with what is universally accepted as correct.

In numerous localities, and especially those where the snails were strongly infected, the same localities which I have of course studied with the greatest care, I found in early spring a large quantity of empty shells and putrefying snails with much corroded shells; simultaneously with these were found another size, only $^{2}/_{3}$ as large; the cuticula was of a fine brown colour; corrosion none, or only detectable at the apex of the shell. These snails grew larger during the summer, and might be present in great quantity during the autumn; they were found in mild winters below the thin ice cover. They were found again in early spring, in some localities in plenty, in others in only a very small number. In three localities, all of them small ponds, where I knew that about 90 or almost 100 per cent of the snails were infected (mainly by Echinostomes and Xiphidiocercariae), the whole stock was now dead, and a border of empty shells was found along the margin of the pond. In another locality (Hulsø) *L. ovata* was present in May-June 1932 in big, very fine specimens; the number was not very large. Three weeks later my assistant and I could not find a single one of the big size, but many small ones. This size was numerous in the autumn; in spring and summer the next year (1933) matters were as in 1932; only the larger size were present. In another small lake, Bagsværd Lake, *L. stagnalis* was numerous in July 1932; in September 1933 it was rare; there were many empty shells, but after two hours' work we had gathered only 50 snails, all infected either with Echinostomes or Furcocercariae. The Trematodes had killed the whole stock. Present were only young snails with a very high spire and not in great number. — I am sure that in very many localities our *Limnaea* species do not live more than one year, and that they are killed by Trematoda. This is also the reason why a snail may be present in a locality in great numbers one year, and be very rare the next; quite similar observations have been made on *L. palustris* in the canals of Indelukket near Hillerød and at the borders of Bromme Lake near Sorø.

Furthermore I am under the impression that localities with heavily infected snails have remarkably large specimens. This holds good especially of smaller ponds. Infection causes excessive growth and size, not the opposite, as might perhaps have been expected.

It is with these observations in mind I am inclined to suppose that in nature the Miracidia and the Cercariae, as observed by Winfield and Nolf and Cort (vide p. 148), only rarely attack the same snail.

5. That the Trematoda have a world-wide influence on molluscs, and perhaps especially on freshwater-molluscs, is beyond all doubt. It would seem that malacologists, in their description of forms and varieties, hardly ever take any notice of this point in their calculations regarding the influence of environmental conditions. In this connection I only wish to point out that the colour of the shell is very often determined by the parasites. The enormous amount of excreta caused by the parasites darken the organs, especially the mantle, but also the shell itself.

In the Furesø heavily infected *Limnaea auricularia* have a perfectly black shell, highly characteristic when laid side by side with a non-parasitised snail whose shell has a very beautiful yellow colour. Infected snails very often have the upper part of the shell black, the lower parts yellow. *Limnaea* strongly infected with Tetracotyle have often a peculiar yellowish-red colour of the shell.

As mentioned above, strong parasitism causes excessive growth; this holds good especially in the last part of the life of the snail, and causes the last winding of the shell to be inflated. Some of the many forms of malacologists are most probably nothing but infected species which, during the later part of their lives have been found to eat enormously in order to satisfy the demands of the parasites with regard to food supply.

6. The most interesting group of the Cercariae are those living a true planctonic life.

There can be no doubt that freshwater lakes harbour a peculiar fauna of pelagic Cercariae, most of them belonging to the Furcocercariae, chiefly to the group pharyngeate longifurcate Cercaria (Miller), but also to the Lophocercaria, the Bucephalus group, and the Cystocercaria groups. According to the preliminary report of Vogel (1932, p. 559) it seems that one of the Cercariae of *Heterophyidae*, the Cercaria of *Opistorchis felinus*, also is pelagic. Vogel says (p. 561) that it "im Wasser schwebt. Der Schwanz ragt in S-förmigen Krümmung nach oben".

In contrast to the sea, fresh water is remarkably poor in pelagic larva stages. It is a well-known fact that most of the marine groups lose their free-living larva stages, according to most authors owing to the smaller specific gravity of fresh water in comparison with the sea. From a planctological point of view it is therefore of no slight interest that we possess a whole group of larvae in our freshwaters, which are actually pelagic. Of this phenomenon planctologists have had so to speak no knowledge at all. This is due firstly to the fact these larvae live such an extremely short time and that most of them are so small that they cannot be caught by our nets or so delicate that they do not come under the microscope in a recognisable form; secondly it is because these larvae are mainly suspended in the midmost waterlayers or over the shellbanks with their living molluscs, which are the very places the fishes seek. The structure of the pelagic Cercariae shows conspicuous adaptations to habitat, and these adaptations correspond with those found in other plancton organisms.

From the moment when I found *Cercaria splendens* in plancton samples from the Furesø (1910) and saw *Valvata piscinalis var. antiqua* throw out its thousands of Furcocercariae (1913) I have had a clear understanding of the phenomenon. My view was strengthened when I caught the Cercariae with closing nets and in water samples taken with the Brönsted apparatus. Their number was always rather small and they were only found in the autumn. Investigations of other kinds have prevented me from publishing results.

Already Ward (1916, p. 12) writes: "These Cercariæ are produced in great abundance and infected molluscs are also abundant and widely distributed. And yet there are almost no records of the occurrence of Cercariæ in the voluminous report on freshwater plancton and aquatic life. I am at a loss myself to explain this condition". This is indeed quite right. In 1904, however, I wrote in my Plancton investigations (p. 130): — "There is no doubt that the pelagic region of our lakes may harbour larvæ belonging to those groups of vermes which as parasites are tied to the fishes or belong to the stones and vegetation of the litoral region. To the first named group belong the larva stages of Trematoda and *Botriocephalus,* some of them owing to the peculiar horns seem (*Bucephalus*) to be well adapted to pelagic life." Whereas, during my plancton investigations, I three times got the *Botriocephalus* larva in my nets, the Trematoda larvae where not found until about 10 years later.

Whereas planctologists cannot be said to have any idea of the Cercariae as members of the pelagic society of our lakes, this cannot be said with regard to the parasitologists. Szidat has remarks (1924a, p. 251) which show that he has seen his *Cercaria C* and other larvae mentioned by him hanging in the waterlayers. It is, however, especially Cort and Brooks (1928c, p. 179) who have mentioned the phenomenon and given drawings of the Cercariae in their suspended position. On this subject they say (p. 211) "Definite specific differences were found to exist in these respects which in some cases make easy identification possible". Because all studies of these plancton organisms have been made in laboratories and quite especially in parasitological ones, it is quite natural that particular stress has been laid upon studies of stimuli which are able to carry the Cercaria to its host (Miller and others). As a supplement to these important studies the planctologist may add the pointing out of the floating power; the life of the Cercaria as a true pelagic organism; the structural modifications of the body in accordance with demands of augmentation of the cross-section resistance to prevent the fall; and the fact that the pelagic region of our lakes possesses an element of which planctologists have had no idea at all.

Chapter XIII.
General remarks.

1. *Adaptation of the Cercaria to the final host and its manner of life.*

On reviewing the plates accompanying this work the first impression of the larva stages is unquestionably surprise at the abundance of forms, and the slight degree of resemblance among the larvae, much slighter than in all the other developmental stages as well as in the mature stage; the great variation manifests itself especially in the larval characters; the form and structure of the tail; the piercing organs with adjacent glands; the equipment of cystogeneous glands, sensitive organs, special larval holdfast organs, planctonic characters. This great variation is all the more remarkable since the freeswimming Cercaria often lives only for a few hours, most probably never for more than about forty-eight hours, Monostomes only for a few minutes (*C. tuberculata* (Wunder 1923b, p. 226). In the adult stage they may live for years, encysted more than one year, and as parthenitae at all events more than half a year. Combined with these variations in structure go variations in behaviour and general biology. In very many cases it may clearly be shown that both variations, the morphological as well as the biological, are in accordance with the life conditions and structure of the auxiliary secondary host or the final host. It seems as if there is an uninterrupted interplay between the Cercaria and its host, its structure and life, in which either encystation or maturity is to take place and that this interplay stamps the parasite morphologically as well as biologically. There are only a few cases in which the uninterrupted interplay between an organism and its surroundings is more obvious than here, and this is all the more striking since the time in which the outer medium is able to stamp the organism is so extremely short.

1. The most conspicuous larval organ is the tail. In the Monostomes, Amphistomes, Gymnocephala, Echinostomes and Xiphidiocercaria it is a swimming organ. The number of strokes it makes in the lifetime of a Monostome is but few, since the animal often escapes from the snail and a few minutes later, attracted by the light, becomes encysted on the lighted side of the vessel; the same may be the case with the Amphistomes and some of the Xiphidiocercaria. In the Gymnocephala and Echinostomes the tail is a powerful swimming organ equipped with a strong transversal and longitudinal musculature. They are organisms which are in search of a secondary host, commonly a bottom organism, often a snail; they are not particularly attracted by light; they mainly live near the bottom; their power of locomotion in a vertical direction is often small, and several of them, e. g. the Amphistomes, chiefly move horizontally. In some of the Macrocercariae the tail is an organ for fixation and for wavy motions,

which either attract the secondary host or cause easier contact with it when it moves over the bottom. Moreover, in this group and in the Cystocercariae the other end of the tail is provided with a bell-shaped cavity in which the Cercaria lives, only connected with the tail by means of a muscle-thread which is broken off when the Cercaria jumps onto the new host.

In the Cystocercariae, Lophocercariae, and Furcocercariae the tail is in the first place a floating organ which allows a suspended position in the middle layers of the water masses and furnishes possibilities for a pelagic life. A furcation of the tail, the development of a furca, is connected with a pelagic life. According to the life of the host which the Furcocercaria is to enter, different types have been developed, viz. bottom forms which stand pelagically near the bottom but with strong power of motion, and whose intermediate hosts are snails; true pelagic forms with a very slight power of motion and which pass passively over onto fishes; surface forms which together with slime secretions reach the skin of mammalia and birds. — In the pelagic forms the furca is remarkably long, often longer than the tail itself, and it is here used as an outrigger to augment the cross-section resistance; in the surface forms, especially *Bilharziella polonica*, the furca consists of two broad leaves which allow the Cercariae to reach the surface quickly, to which they then adhere by the ventral sucker. In the Microcercariae the tail is only a short blunt rudiment; if they leave the snail at all, the species are slow creeping organisms in search of other snails. Finally, the Cercariaea have no tail at all; they either encyst in the snail in which they are hatched, or seek the antennae of the snail, or creep slowly as leaches on the bottom, where they are taken up with the snails by snail-eating bottom organisms. A very peculiar form of adaptation is found in those cases where the reduced tail can be withdrawn into the chamber and the latter be changed into a floating organ which alters the form to a real pelagic organism. This is the case with *C. cystophora* Wagener and *C. mirabilis* Braun, the former developing in small *Planorbis species,* the latter in *Limnaea palustris.*

A still more peculiar adaptation is that of *Cercaria duplicata* (Baer) from *Anodonta,* best studied by Wunder (1924a, p. 323). Reuss (1903, p. 458) and Wunder have shown that the peculiar broad tail is used to form a highly remarkable "Schwanzcyste", which is found at the bottom of the vessels in which infected mussels are kept. According to Reuss the cyst is caused by a floating out of the cuticula, whereas Wunder shows that it is due to an invagination. The result is a hyaline ball equipped with longitudinal furrows and containing the distome. These balls lie on the bottom and roll over it.

2. A similar variation and the same very conspicuous correlation to the surroundings is also very obvious with regard to the presence or absence of the piercing organ. It is lacking in all those groups which are introduced passively as cysts into the final host. This is the case with the Monostomes, the Amphistomes and the Gymnocephala, and may also be the rule at all event for several of the Cercariaea forms. Whether the cysts are eaten together with the water plants, as is the case with

the Monostomes and at any rate with some of the Gymnocephala, or with the grass of inundated meadows (some Gymnocephala) or with the stratum corneum of the Amphibia (some Amphistomes), in all cases the result is the same. This is also the case with the Echinostomes, which, however, in their rows of spines have a powerful holdfast organ which perhaps already functions when the Cercaria, after a short excursion in the open enters a snail and encysts in it. As a rule it is not combined with any secretory system used during the penetration of the skin.

True piercing organs are in the first place the stylet in the Xiphidiocercariae, Macrocercaria and Microcercaria and if present also in the Cercariaea; next the various piercing organs in the Furcocercaria. Combined with the stylet there is always a system of stylet glands which differs in size and place from species to species. It consists of a number of glands with long ducts which debouch near the base of the stylet. Most of all these forms use as secondary hosts Arthropoda, in the first place insects, but also Crustacea, in which they encyst. Direct observations have shown how the stylet is used as a piercing and cutting organ by means of which the Cercaria pierces a hole in the cuticula. It is possible that the penetration glands secrete a fluid which has a destructive effect on the cuticula. That this secretion at the same time is poisonous is highly probable, for the insects, when a large number have passed the cuticula, die or at all events show signs either of great excitement or of great feebleness. Within my knowledge, all stylet Cercariae always encyst in the interior of the host, never exteriorly. As soon as the Cercaria has reached its place of destination and encystation has taken place, the role of the stylet is at an end; it passes over into the encysted stage but lies apart, often between the Cercaria and the interior wall of the cyst. Together with the throwing off of the stylet there also occurs, as far as I have been able to see, a breaking down of the penetration glands. The size and form of the stylet varies from species to species, and in accordance herewith the different species are only able to use such arthropoda as intermediate hosts whose skin the stylet is able to pierce. If two different species of Xiphidiocercariae are placed in a vessel with *Corethra plumicornis* I have observed that both try to pierce the cuticula but only one of them is able to do so, the other not.

True piercing organs of quite another structure are found in all Furcocercariae. The penetration glands are here strongly developed; their number and place vary from species to species; together with the long ducts they fill a great deal of the interior of the snail. In all those forms which pass through a second larva stage (Tetracotyle, Diplostomum, Tylenchus etc.) the oral sucker has still preserved some significance as an organ of attachment; nevertheless its importance as such is but small; it is protrusile in very different degree in the different species; it acts as a penetrating organ and at its top it is equipped with small spines or taps, at the base of which the ducts from the penetration glands debouch. In the Lophocercaria it is provided with two small tips which perhaps may be hollow. In the Furcocercaria of the group *Schistosomatidae*, without an intermediate host or a secondary larva stage, the whole system with its anterior protrusile penetrating organ and the penetration glands has reached a stage of development not known in any other group of Cercariae. In conjunction the two parts, the penetration organ and the enormously developed ducts and glands, fill the greater part of the interior, only leaving room for the excretory system and the rudimentary alimentary canal. The oral sucker is modified to a powerful penetrating organ with a sharply defined posterior, very muscular, part, and an anterior part, on the tip of which the very broad ducts debouch. The penetration glands are of a complicated structure, the different pairs giving a different chemical reaction.

3. Pronounced larval organs are in the first place also the holdfast organs which are found in different groups of Cercariae. To these belong the peculiar locomotoric pockets situated at the lateral angles of the body of the *Monostomes*, which in some cases are provided with glandulae and in others with spines. In these animals which lack the ventral suckers they act as larval feet with which they fasten themselves, especially immediately before the moment of encystation. Similar caudal pockets armed with needle-like spines are found in some of the Xiphidiocercariae (*Xiphidiocercariae armatae*); they may act in the same manner. Another holdfast organ is the corona of spines in the Echinostomes, but this organ may have its greatest significance in the mature stage. Therefore, in contradistinction to the stylet of the Xiphidiocercariae it is not thrown off in the encysted stage but preserved during and after encystation. As holdfast organs may also be interpreted the abundantly developed small spines and bristles especially on the anterior part of the Furcocercariae. They are simultaneously part of a penetration- and of a holdfast organ used by the animals during the penetration through the skin of the host. The incredibte hurry — often only a fraction of a minute — in which the piercing of a host, e. g. a snail, takes place, shows the effectiveness of all the different parts of the piercing and holdfast organs. This is also partly due to the enormous power of contraction and extension of the snout-like forepart of the body, perhaps most conspicuous in the *Lophocercaria* (Pl. XX, figs. 1, 3, 5).

4. Another characteristic larval organ is the whole cystogeneous apparatus whose secretion is used to form the capsule of the cyst. It seems only to be totally lacking in the Furcocercariae. In the Monostomes and Amphistomes it consists of numerous cells spread over the whole body. Apart from the nucleus they commonly contain rhabditiform granules, in other cases the content is granular, homogeneous, often milky, opaque. During the encystation process the cells open everywhere upon the surface of the body; the content is given off and in connection with the surrounding medium altered into a gelatinous capsule. In the Gymnocephala and Echinostomata where we find similar cystogeneous glands, these are often arranged in broad dark bands, lying between the alimentary canal and the body wall. I am of opinion that here also the glands open all over the body. With regard to their function I refer the reader to Wunder.

As mentioned above, no cystogeneous cells are found in the Furcocercariae; this is in accordance with a mode of life differing from that of all the other Trematoda. Either the Furcocercariae, on having reached an intermediate second host which in some cases may be the same as the first one, give rise to a new larva stage, or they possess no intermediate host and immediately enter the final one, in whose blood system they live and attain maturity.

5. As free-living organisms the Cercariae are equipped with sensitive organs which have no significance in the parasitic stages of the life of the species. Among them may mainly be mentioned the eyespots, which seem best developed in some of the forms that encyst in the open and not in the interior of other organisms (Monostomes and Amphistomes), and in some of the *Schistosomatidae* which seek the surface in expectation of the host in which they are destined to attain maturity. All forms equipped with eyespots are phototropic, they so to speak dart towards the lighted sides of the vessels, either to encyst (Monostomes) or to fasten themselves there (*Schistosomatidae*).

6. As special larval organs may also be pointed out those organs and structures which may be of significance for all the Cercariae that live a pronounced pelagic life. Among these must in the first place be mentioned the peculiar folded membrane on the dorsum of the Lophocercariae; the very peculiar pear-shaped house of the *Cystocercaria C. splendens,* in reality only the dilated upper part of a tail, further the membranes along the tail or the furca found in the Furcocercariae and the peculiarly formed furca of the *Bucephalidae* (by means of which the animals, according to one author, are said to "fly like eagles through the water" (in every respect a rather peculiar comparison). As mentioned above, the long furca in many of the Furcocercariae may also be regarded as plancton-characters. In this connection may also be mentioned the great hyalinity which characterises so many plancton organisms and which is especially conspicuous in the cystocercous Cercaria *C. splendens* and in many other Furcocercariae.

All the above-named organs, the tail, the piercing organs, the cystogeneous cells, the holdfast organs apart from the suckers, and the sensitive organs, all varying in development and structure from group to group, and often from species to species, are all larval organs many of which are only in use during a few minutes of the life of organisms which, when all their different stages are included, may live for years. The development of the piercing organs, of the tail, of the cystogeneous cells and the sensitive organs, clearly evidence the adaptation to the nature of the surrounding medium in which the next stage of the development is to take place and where the accommodation to the manner of life and structure of body of special hosts is carried out on a more elaborate scale (*Xiphidiocercaria, Schistosomatidae*).

Two organs seem very little altered by life in a free-living stage, viz. the alimentary canal and the excretory system. During the short time the species live in the free stage no food is taken, but during the time in which the Cercariae lie free in the tissues of the snail, a time which may be very long for the Monostomes as well as for the Amphistomes, it is a question whether the alimentary canal does not function. In any case the contents of the intestinal coeca seem to show this. Of all the organs the excretory system is that which is least subject to alterations and adaptations, and so it is that which most resembles the organ in the mature animal. In accordance herewith it is also the organ which has the greatest systematic significance, but according to its structure that which is most difficult and therefore also most dangerous to use for systematic purposes, especially when it is used in an extremely one-sided manner.

2. *Some remarks with regard to the Sporocysts, the Redia and Cyst stages.*

I shall not here undertake a survey of the different hypotheses and theories which from the time of STEENSTRUP down to our day have been set forth to elucidate the highly complicated life history of the Trematoda. For years I have been inclined to suppose that the process of polyembryony should be applied to Trematode life. Later on I learned that DOLLFUS (1919, p. 124) had advanced the same view. I shall restrict myself to refer the reader to the paper of BROOKS (1930, p. 299). As far as I can see, he is nearest to the truth when he interprets the life history of the Trematoda "as one in which the germinal lineage passes through successive larvae stages in which polyembryony features as a mode of multiplication and in which precocious cleavage is an activating factor".

Here I shall merely offer some remarks on the Sporocyst, Redia stage, and Cyst stage.

It is a well known fact that the Cercariae in some cases develop in Sporocysts in others in Rediae. The Xiphidiocercariae, all Furcocercariae including Lophocercariae, Bucephalidae and most of the Macrocercariae develop in Sporocysts; the Monostomata, Amphistomata, Gymnocephala, Echinostomata and Cystocercariae develop in Rediae. From this rule there may be exceptions, but they are few, and some of them rather doubtful. It has often been pointed out that it may be rather difficult to determine whether we have to do with a Redia or a Sporocyst; the posterior locomotoric organs may especially in older Rediae be entirely absent; the gut may be very strongly reduced or totally lacking. Only a pharynx, which also may be very much reduced, shows that we have a Redia before us. In those cases where it serves as a birth-pore, as seems to be the case in the Cystocercariae (*S. splendens* Szidat), the developmental stage may almost equally well be regarded as a Sporocyst and as a Redia. We find these intermediate stages especially among the Microcercariae and in most of the Cercariaea; in these cases the pharynx may have its principal significance as a holdfast organ; the rudimentary gut or intestine would seem to have no particular significance as an organ for taking in food or as a magazine for nutritive matter.

We suppose that a Sporocyst stage is always intercalated between the Miracidium and the Redia stage. From this rule we know only a single exception, namely *Tracheophilus sisowi* Skrj. whose Miracidium contains ripe Rediae, a Sporocyst stage being omitted (pag. 20).

In this connection, however, I would point out the fact that we know large groups in which Sporocysts have hardly ever been observed and with regard to which, therefore, it has been maintained that Rediae develop directly from the Miracidia. This is especially the case with the Echinostomes (Johnson 1920, p. 342). I confess that I have been of the same opinion. In spite of the many hundred snails which I have observed to contain Echinostomes, I have never seen a Sporocyst. This has, however, been observed by Mathias (1925, p. 66) in *C. Hypodereae conoideae*. Even if in these forms too a Sporocyst stage is intercalated between the Miracidium and the Redia stage, there is no doubt that in the development of the Echinostomata, and I suppose also in that of the Monostomata and Gymnocephala, the Sporocyst stage plays a very insignificant role as a multiplicating factor compared with that of the Redia stage.

At the first glance it seems rather fruitless to speculate as to why the Cercariae in some groups develop directly from a Sporocyst in others from a Redia, but it is of interest to note how much the Sporocyst and the Redia stage differ from each other, especially with regard to propagation, but also with regard to power of motion and manner of nourishment.

1. Between the Sporocyst and the Redia there is, with regard to propagation, a fundamental difference which has not been sufficiently stressed and curiously enough has even been denied (Szinitzin), namely that the Sporocyst has the power either of division or ramification, which the Redia has not; ramification is only found in a few cases: viz. in *Leuchochloridium, Bucephalus* and *Distomum leptostomum;* the power of division is characteristic of the Xiphidiocercariae (p. 82 a. o.) and Furcocercariae; in the latter case in very different degree in the different species. In the long threads constrictions arise, and in the constrictions dark lines appear, whereupon the Sporocyst either breaks up into a series of smaller pieces or only the extreme part is thrown off; the length of the Sporocysts depends on how often the divisions take place; in some species the pieces are almost isodiametric, in others they are very long, threadlike; both cases occur among species of Xiphidiocercariae. — The different stages of division are very conspicuous in many Xiphidiocercariae, Mathias (1925, p. 48) has seen them in Furcocercariae, but the Sporocysts of Gymnocephala show the same phenomenon. Thomas (1883a) has shown them for the Sporocyst of *Fasciola hepatica* (fig. 9, Pl. II). In the very long, extremely thin, thread-like Sporocysts of Lophocercaria they have not been observed.

In these cases, at any rate in the Lophocercariae, the long threads are equipped with a sucker-like formation with which they are fastened.

The smallest pressure on the cover causes the long threads of many Xipidiocercariae to go to pieces, and form spirals. There can be no doubt that these pieces are carried with the blood-stream through the whole snail and so obtain a hold everywhere, in the intestine, in the mantle etc.

As a rule the power of locomotion of the Sporocyst is but small, especially when it gets older, and the "paletot" prevents the motion, the detached parts are mostly carried away with the blood. Almost always the attack begins from the lower part of the alimentary canal from which they slowly invade the whole liver. In those cases where we have to do with extremely long, very thin, threads, as is the case in many

Furcocercariae, a division of the threads is not so often observed. It is a question, as pointed out also by other authors, if these entangled masses are not in reality ramified Sporocysts.

As far as we know, the Rediae never possess any power of division; in the Monostomata and especially in the Echinostomata the indentations may be very conspicuous and cause the brood-chambers to be marked off from a digestive part containing the pharynx and the gut; but there is no evidence of a separation of the two parts.

2. Another characteristic of most of the forms in which Cercariae develop directly from a Sporocyst is the enormous production of brood. This is especially the case with all Furcocercariae, and with many of the Xiphidiocercariae with long thread-like Sporocysts. The Sporocysts are crowded with brood, as pointed out already by Fuhrmann. Dubois (1929, p. 111) shows that in the course of an hour a snail can throw out more than 20,000 Cercariae. In the course of a few hours the water in vessels with infected snails may become quite whitish.

Whereas Sporocysts, where the Redia-stage is lacking, may be regarded as storing magazines often for thousands of Cercariae, all ripening almost simultaneously, the Rediae only rarely contain more than about 20—25 Cercariae and commonly a much smaller amount. Snails infected with Echinostomes and Gymnocephala never give off clouds of Cercariae simultaneously, but only rather a modest amount of about some hundreds at the height of the production.

3. In contradistinction to the Sporocysts there is some evidence for the fact that the Rediae are able to produce sets of Cercariae which ripen successively (Monostomes). In that case, however, the Cercariae leave the Rediae at a very early stage of development and are nourished directly in the tissues of the snail outside the Redia. This is the case with the Monostomes and Amphistomes, where the number of Cercariae is much larger than that of the Rediae. This is e. g. the case with *C. ephemera* in *Planorbis corneus,* from which thousands of Cercariae may come out when it is opened, whereas the number of Rediae is much smaller.

Now and then, lying among the amounts of extremely thin threads packed with brood, we find a single very long, 2—3 mm, remarkably thick Sporocyst, commonly with thick wrinkled walls filled with a greyish substance and only containing a few fully developed Cercariae; it has often a snout-like tip and a birth-pore. This Sporocyst may perhaps be regarded as the mother sporocyst whose power of propagation is now exhausted; if there is any motion, this is only found in the snout-like part. Of these mother sporocysts I have only found a single specimen in each snail (Pl. XX, fig. 6; Pl. XXII, fig. 4; Pl. XXVI, fig. 5; Pl. XXVII, fig. 5). It must be extremely old, most probably it will often hibernate, giving off the daughter sporocysts. As far as I can see, the number of generations of daughter sporocysts is but small. Lying in the mother sporocyst, the daughter sporocyst is packed with germ-balls, all almost isodiametric. In no case have I seen these daughter sporocysts produce a new Sporocyst generation among the Xiphidiocercariae and Furcocercariae. They always develop

Cercariae, but the rate of development is dependent upon the temperature. It is very slow during winter, and extremely rapid during summer.

With regard to the Rediae I have never found specimens which could be designated as mother rediae in the same sense as the above named mother sporocyst.

I am inclined to think that the Trematoda which have no Redia generations conquer the body of the snail mainly by means of their power of partition, those which possess Redia generations by means of series of generations of Rediae. Detached parts of the Sporocysts are spread by means of the blood, the Rediae are active wandering organisms. Especially the young stages of the Redia possess a great power of locomotion; this combined with an enormous power of contraction and extension of the body enables the Redia to make its way through the narrowest sinuosities in the snail. As is well-known, in heavily infected snails, there is no organ which cannot be packed with echinostome Rediae.

Where Rediae do not occur, the parasites hibernate as Sporocysts packed with germ-balls which in spring develop into Cercariae at higher temperatures; where Rediae occur, the hibernation takes place mainly in that stage; these hibernating Rediae mostly contain daughter rediae but also almost fully developed Cercariae which remain in the Rediae for months. As often pointed out, daughter rediae and Cercariae are often found in the same mother redia. We are unable to show with certainty what makes a germ-ball develop into a Cercaria or into a Redia. As already Dubois (1929, p. 128) has pointed out, it is most probable that variations in temperature are most effective. The number of Sporocyst and Redia generations differs from species to species and differs at the different seasons of the year. During summer the production of Cercariae is much more pronounced than in winter, and at that season of the year heavily infected snails may often be found in which all Rediae are in Cercaria-production and young Rediae very rare (p. 56—57). It is, however, quite impossible to think of finding rules for the development; as stated above, specific as well as seasonal variations make their influence felt everywhere; to this must be added the time of infection, the age of the snail, its state of health and conditions of nutriment. Especially this latter factor may, as mentioned above, cause great alterations in the life conditions of the parasite and force the Cercariae to encyst even if they are still enclosed in the parthenitae. On p. 15 it has been mentioned that *Cercaria ephemera* may hibernate in the snail; on p. 75 that the Xiphidiocercariae do the same.

I have been unable to find any regular seasonal fluctuation in the parasitation of the snails. As far as I can see other authors have arrived at the same result (Mac Cormick 1923, p. 163; Mac Coy 1928b, p. 121; Miller and Northup 1926, p. 490).

I possess no more thorough investigations as to the number of Cercariae escaping from the snail host; the time of day when they mainly escape; and their dependence in this respect on temperature, light and the height of the barometer. On these points I refer the reader especially to the investigations of Cort (1922, p. 177) and Dubois (1929, p. 109).

Most of the species throw out their Cercariae when the barometer is high. It is only in bright sunshine that I have seen milky water round the large *Limnaea* and *Planorbis* species in Nature. It has always been due to Xiphidiocercariae. In the laboratory too milky water in the vessels was most pronounced on days with bright sunshine. The escape mostly took place before 12 o'clock but especially many Furcocercariae were thrown out the whole day long. When snails were under observation for weeks, a regular periodicity independent of all outer conditions was quite conspicuous; that this periodicity was caused by a periodicity of the ripening of the Cercariae in the parthenitae could be shown with certainty with regard to the Furcocercariae.

While the biological differences between the Sporocysts and Rediae are being discussed, there is still one point which must be mentioned, namely the different mode of nutrition. In the Sporocyst all nutrition must take place through the body wall. We see how the tissues of the snail are broken down; and how the Sporocyst increases in size, but as far as I know, we have no clear idea of how the parasite gets its nourishment.

With regard to the Rediae with a well-developed pharynx and gut there is no doubt that they directly nip out large portions of the liver by means of the pharynx and take it into gut. If daughter rediae of different ages lie in the mother redia it can also be observed that the oldest one eats the younger Rediae as well as the germ-balls. When very old mother rediae contain only remarkably few daughter rediae and almost no other brood, it seems highly probable that the Rediae have eaten up all the brood and have now become too large to be born in a natural manner through the birth-pore.

The gut itself almost always contains a yellowish fluid in which darker grains of different sizes are observed. This fluid is yellow in species inhabiting *Limnaea;* in those from *Planorbis corneus* it is red. I think it is allowable to suppose that these Rediae, especially those of the Echinostomes, take in the blood of the host as well as portions of the organs in which they lie.

As mentioned above, it is often difficult to distinguish a Sporocyst from a Redia. In those cases where only a pharynx and a very rudimentary gut is present, there can presumably be no doubt that here too the nourishment is taken through the body wall. The gut, often not longer than the pharynx itself, in these cases often contains a black mass of unknown origin. The structure of the alimentary canal seems to show that the Cercariae after they have left the Sporocysts or Rediae as a rule take in no food; in the free-living stage and in the encysted stage this seems also to be the case. There are, however, two exceptions; in the Monostomes and Amphistomes the taking of nourishment goes on long after the Cercariae have left the Rediae, the long intestinal coeca are filled with a yellow fluid containing numerous grains; this seems to show that the Cercariae have taken in food through their mouth during their stay in the mollusc. The other case is the second larva stage of all those Furcocercariae which possess a Tetracotyle stage. The enormous growth of the parasite in this free creeping stage and the great destruction done to the tissues of the host seem to show that we are here concerned with a very vigorous process of nutrition.

The cysts. Apart from the Trematoda which attain maturity in the blood (*Schistosomatidae*) almost all other Trematoda pass through a resting stage in which as a rule no nourishment is taken, in which the sexual organs ripen, and organs which are of significance for the mature forms, for instance organs for fixation (the collar thorns of the Echinostomes, the holdfast organ of the Holostomata) attain their full development. The duration of the encystation stage is subject to great variation in the different species. It is problematic for all species which develop in the eyes of fishes, and it is aberrant from the normal stage in all(?) those forms which possess a true Furcocercaria stage (Tetracotyle). In most cases the cyst is of circular outline, watch-formed and hyaline. In that case the material for the cyst-wall is supplied from the cystogeneous cells. The process of the formation of the cyst-wall has been studied by Bovien and Wunder to whose papers I refer the reader.

The encystation normally takes place either(1) in the open on vegetation, stones and the shells of snails or(2) in an auxiliary host belonging to almost all groups of the animal kingdom. Where encystation takes place in the open, the Cercariae possess no piercing organs of any kind. The first of these groups may be divided into two (1a, 1b) the other into 3 (2a, 2b, 2c).

1a. The Cercariae are strongly phototactic and usually possess eyespots (*Monostomata, Amphistomata*). A Redia stage is the rule, but the Cercariae are nourished outside the mother Redia directly from the tissues of the snail. The swarming of the Cercariae takes place in bright sunshine; in cloudy weather they remain in the snails. The Cercariae are all restless swimmers, but their free-living life is very short, not more than about 24 hours, and for many Monostomes normally only a few minutes; the cysts are often found in cakes, especially on shells of snails. There is no auxiliary host, and the cysts are introduced passively with the food.

1b. Of the other group, to which the Cercaria of *Fasciola hepatica* belongs, our knowledge is extremely restricted. Normally encystation seems to take place in the open, in some cases it has been shown that it may take place in snails (perhaps an aquarium phenomenon). A Redia stage is the rule, but the Cercariae do not leave the Rediae until they are to leave the snail. In my vessels Gymnocephalus Cercariae are often given off in cloudy weather; they are all bottom forms, some are content with very small water areas (*Fasciola*). Without auxiliary hosts they are transferred with the food to the final host.

2a. In the group which encysts in auxiliary hosts, the Echinostomes have a special place.

At our present stage of knowledge it seems as if the encystation here takes place in the same group of animals in which the parthenitae have developed, namely in Molluscs. It seems as if some species live as parthenitae in one species, as cysts in another, but in very many cases the same species is used, and for some species it has been shown that encystation takes place in the same specimen in which the parthenitae have been developed (aquarium phenomenon?). Whereas the Rediae are found everywhere in the snails, the cysts are found mainly in the auricle, in the lungs, in the mantle and in the foot tissues. Eyespots are almost always lacking, all piercing organs also; the collar spines most probably cannot be used for that purpose; the Sporocyst generation at any rate plays a very inconspicuous role, and the Cercariae are developed inside the Rediae. It has often been shown that the Cercariae never come out of the Rediae and may encyst in them. Whether or not this is a normal phenomenon, we do not know. They are bottom forms with a very brief free-swimming period. The final hosts are mainly snail-eaters and are transferred either with the snails to the alimentary canal of birds, chiefly waterbirds, or with the mud.

2b. In the second group encystation takes place within a secondary host which as a rule does not belong to the same group of animals in which the parthenitae live, mainly Arthropodes. This renders it necessary that the Cercariae should be able to force their way through the cuticula of their hosts. These forms are all equipped with piercing organs, almost always a stylet at the base of which glands, which may be regarded as poisonous, debouch. By poisonous glands we mean, such as exert a dissolving influence upon the cuticula. As directly observed, the stylet is used as a knife which is moved forwards and backwards and with which the Cercaria cuts a rent in the cuticula. The structure of the stylet varies greatly and it may presumably be supposed that there is some correlation between the structure of the stylet and the material which it is meant to pierce. Most of the Cercariae of this group belong to the Xiphidiocercariae, but also the Macrocercariae, the Microcercariae and the Cercariaea may provisionally be referred to it. Much work must be done before this can be proclaimed as established fact. A closer examination will presumably show that a greater or less number of all these forms belonging to the three last-named families have no auxiliary hosts, but that encystation takes place in the snail in which parthenitae have been developed, whereupon the cysts are transferred directly to the alimentary canal of snail-eating animals. Some of them encyst in Arthropoda (viz. *Potamobius*), which in this case is used as intermediate host.

The main group, the Xiphidiocercariae, normally, if not always, use an auxiliary host, often but not always, Arthropoda and, mainly, insect larvae. It is the cysts of this group which are found dispersed in the most different groups of the animal kingdom. Often encystation takes place directly below the skin, but very often the cysts are found deep down in the interior of the animals, and in the most different organs. — Encystation never as far as hitherto known, takes place in the open, but fairly often in the snails in which the parthenitae have been developed. In that case cakes of cysts may be found on the liver, or the whole liver may be filled with cysts. But this phenomenon is most probably not a normal one. It occurs when the snail is dying; in the encysted stage the animals can endure the putrefaction of the snail, but not in the other stages.

Where an auxiliary host is intercalated between the snail and the final host, it is clear that a much smaller amount of the progeny will attain maturity than when the transfer is direct from snail to final host. All Xiphidiocercariae produce enormous amounts of Cercariae.

It would seem that Sporocysts are able to develop a greater amount of progeny than Rediae, in accordance herewith, we find no Redia stage in the Xiphidiocercariae; the whole development of Cercariae takes place in the Sporocyst stage. In the three other groups provisionally referred hereto occur the parthenitae which with almost the same right may be referred to Sporocysts as to Rediae. The Xiphidiocercariae are very active swimmers; as a rule eyespots do not occur; they may live about two days; if an auxiliary host is not found, they sink to the bottom. In vessels with swarms of Xiphidiocercariae these will on the second day dart to the bottom and here form a milky layer often 1 centimetre thick. It is precisely the Xiphidiocercariae which most commonly in Nature form "milky water" round the snails.

It is characteristic of the cysts belonging to this group that they are hyaline, and that the cyst-wall is very thin, not composed of several layers as is the case with that of the Monostomes, and commonly not so thick as that of the Gymnocephala and Echinostomata. It corresponds to this that the cystogeneous apparatus is commonly rather feebly developed and does not fill the body to such a degree as is the case in the Monostomes, Gymnocephala and Echinostomes.

2c. Peculiar forms of cysts are the Tetracotyle stage of the Furcocercariae and the Agamodistome stages in some of the Cercariaea: *Leucochloridium*. Referring the reader to p. 151—157 I shall here merely remark with regard to the Tetracotyle stage that between the free-living Cercaria stage and the Cyst stage there is intercalated a creeping parasitic stage in which the parasite takes food endosmotically, and the size increases enormously. Sooner or later, combined with diminution in size, the Tetracotyle is formed. Just like many Echinostome Cercariae the Furcocercaria enters the same species of snail in which it has been developed and occasionally the same specimen. How the Tetracotyle is transferred to the final host we do not know with certainty. The Cercariae during their short lifetime live an almost pelagic life. They are always produced in Sporocysts and always in enormous numbers. — There is no Redia stage. The Cercariae show adaptations to pelagic life. There are no cystogeneous glands developed in the free-living Cercaria stage and the rather complicated wall of the Tetracotyle must be developed from material worked out by the creeping flattened larva stage.

The encystation processes of the Cercariaea to which many of the Trematoda living in snails with amphibious or terrestrial habits belong, are very little known. They exhibit many very peculiar phenomena; only the Agamodistome stage of *Leucochloridium* is known (Heckert).

3. *Upon Host Preference.*

If we try to gain some knowledge from the literature of the behaviour of the Miracidia in their relation to the different mollusc species, it is very difficult to get a clear idea of the real facts. Many authors, especially from older times (Cort 1918d, p. 170), seem to be of opinion that the Miracidia show no specific host preference but that they will be attracted by and use for their further development very different species. My own observations, all based upon studies in Nature, lead to results which are not in accordance with the old opinion. It cannot be denied that *Fasciola hepatica* in the different parts of the world uses very different hosts. On the other hand, investigations in Europe clearly show that the parasite out of the whole Mollusc fauna of a locality really only uses a single species: viz. *Limnaea truncatula*. As far as I can see the Miracidia show a pronounced predilection for distinct species available in a given locality. Furthermore many observations seem to show that many Trematoda are really strictly tied to a single species or to the members of a single genus. In the following, examples will be given of all these phenomena. Species which develop in the genus *Limnaea* may be able to use the different species of this genus but for my own part I have seen no examples where species which use *Limnaea* also use *Planorbis* species. Those which use *Planorbis corneus* are only rarely found in the small *Planorbis* species, and even these have their own fauna (e. g. the Amphistome *C. diplocotylea*). Those Cercariae which use Pulmonata are only very rarely found in branchiate snails, and vice versa. Especially *Bithynia* has its own Cercaria fauna strictly limited to it, and the same seems to be the case with *Valvata*, whose Trematode fauna hitherto seems to have been unknown. My results seem to accord well with the papers of Lühe (1909) and Dubois (1929) as also with those of other authors.

In his paper on the development of *Strigea tarda* Mathias (1925, p. 54) shows that the Miracidium has a pronounced predilection for *Limnaea stagnalis*, but that it may develop in *L. limosa* (= *ovata*) but not in *Planorbis corneus;* this is entirely in accordance with my own results.

Everywhere in Europe the same seems to be the case with *Fasciola hepatica*, whose host is *L. truncatula;* it may penetrate into *L. pereger* but it is alleged that the development cannot be completed there. For *Hypoderaeum conoideum* Mathias (1925, p. 76) has shown that "les *Planorbes* et *Limnœa palustris* étaient réfractaires a l'infestation. Les *L. stagnalis* et les *L. limosa* au contraires se contaminaient assez facilement".

The Gorgoderinae are only found in *Sphaerium corneum*. It is very peculiar that all the Danish Gymnocephala are only found in *Bithynia tentaculata;* with regard to Switzerland Dubois (1929, pp. 37—43) comes to the same result. Also Lühe (1909, p. 183) mentions *C. tuberculata* Fil., *C. papillosa* Ercol., *C. crassicauda* Ercol., *C. cucumerina* (Ercol.) *C. fulvopunctata* Ercol. from *B. tentaculata* only; *C. magna* Pagenst. has been found in the related *Paludina vivipara*. Only *C. agilis* Fil. and *C. neglecta* Fil., both, as far as I know, found only once in Italy and never later, are found in *Limnaea* species, and this is also the case with *C. fallax* Pagenst. (*Limnaea stagnalis*). On the other hand, none of my 8 Echinostomes and none of Dubois's 13 Echinostomes occur in *Bithynia;* almost all belong to *Limnaea* species. Of the European species, within my knowledge, only the easily recognisable *C. echinatoides* (Fil.) is known, everywhere only from a single snail, *Paludina vivipara;* and *C. Echinoparyphii recurvati* as a Redia only from *Planorbis* species: *P. corneus* (Mathias 1927, p. 291) and *P. umbilicatus* (mihi). The group *Virgulae* of the Xiphidiocercariae are strictly limited to *Bithynia tentaculata* (Lühe 1909, p. 199; Dubois 1929, p. 76; mihi) *C. ocellata* is everywhere found only in *Limnaea stagnalis* as the main form, rarely in *L. ovata; Bilharziella polonica* only in *Planorbis corneus*. In the small pond Hørsholm Pond *Limnaea* and *Planorbis* lie side by side, but nevertheless each of the two snails has its own Schistosome; all investigations in other countries corroborate the fact. The whole *vivax* group of the Furcocercariae in Europe is strictly limited to *Bithynia tentaculata;* in Egypt and Tunis it occurs in *Cleopatra bulimoides* and *Melanopsis praemorsae*. The Monostome *C. ephemera* Nitzsch is everywhere found only in *Planorbis corneus, C. monostomi* v. Linst. only in *Limnaea* species (Dubois 1929, p. 51) or *C. imbricata* Loos in *Bithynia tentaculata* (in Egypt in *Melania tuberculata* (Loos 1900, p. 193)). The Amphistome *C. diplocotylea* Fil. occurs in small Planorbis species, perhaps in *P. corneus*.

Especially Faust has clearly shown in a series of very instructive papers (1924 b, p. 199; 1931, p. 373; 1932, p. 350; Faust and Meleney 1924) that the three human species of blood-flukes utilise entirely different species of molluscs, and that the Miracidia (1924 b, p. 202) may show specialised adaptations to biological peculiarities of special molluscs. Just this point is of course of the greatest significance for all nosogeographical studies, Faust (1931, p. 373; 1932, p. 351) mentions that Korea which lies midway between Central China and Japan is free from blood flukes because the mollusc host of *S. japonicum*, members of the genus *Oncomelania*, is not found in Korea. Furthermore he states that *S. mansoni* which was introduced into the western world by the African slaves has never gained a footing in U. S. A. but only in South America and portions of the Caribbee Islands which has the genus *Planorbina* in common with the native continent of *S. mansoni*, namely Africa. Attempts to infect the subgenus *Heliosoma* of the genus *Planorbis* common in the vicinity of New Orleans had not been successful. To the absence of the right snails Faust refers the fact that the United States has been hitherto spared by Bilharziosis.

With regard to Egypt, Manson (1920, p. 32) maintains that wherever the *Planorbis* (the host of *S. mansoni*) is present, rectal Bilharziosis will be found, and wherever *Bulinus* (the host of *S. Haematobium*) abound, the urinary form of the disease will be the most prevalent. See also Cawston (1918, p. 69).

Furthermore, if we study the Cercaria fauna in some of the localities mentioned on p. 178, we shall arrive at exactly the same result.

Near the borders of the Furesø at the coast of Frederiksdal is a small ditch only about 40 m. long and 2 m. broad and in spring not more than 1 dm. deep; in summer it may be almost totally desiccated. It is filled with water-plants. In this very small water area *Planorbis umbilicatus* is abundant, whereas *P. corneus* is very rare. *P. vortex* is almost as common as *P. umbilicatus*. Of the *Limnaea* species *L. ovata* is common, *L. palustris* rather rare. I have only been able to find 30 specimens in the course of about two hours. Of *Limnaea stagnalis* only one old specimen and nine young ones were found. *Bithynia tentaculata* was only present in very few specimens; only 10 could be found.

When the material was dissected, it could be shown that *Planorbis vortex* (50 specimens) and *Limnaea ovata* (50 specimens) were not infected at all. The other species were all infected and in the following manner:

Planorbis corneus by a Monostome, *C. ephemera* to the number of	4 of 30	specimens
Tetracotyle	2 - 30	—
Planorbis umbilicatus by an Echinostome: *C. Echinoparyphii recurvati*	7 - 40	—
— — a Furcocercaria *C. F_1 Harper*	8 - 40	—
Limnaea stagnalis by an Echinostome, *C. echinata*	1 - 10	—
— *palustris* by a Monostome: *C. monostomi*	1 - 30	—
— — by an Echinostome, *C. echinostomi*	9 - 30	—
— — by a Xiphidiocercaria, only Sporocysts	5 - 30	—
— — by a Furcocercaria: *A. Szidat*	7 - 30	—
— — by Tetracotyle	30 - 30	—

Of course we have no idea of the manner in which the different Trematode eggs have arrived in this little piece of water, nor when they are hatched. On the other hand, the list clearly shows the predilection of the Miracidia for the various molluscs. *C. ephemera* has only developed in *Planorbis corneus;* the Echinostome Cercaria *C. echinopharypii recurvatum,* only in *P. umbilicatus; C. echinata* only in *Limnaea stagnalis;* and *C. echinostomi* only in *L. palustris;* the *Furcocercaria* F_1 Harper only in *P. umbilicatus;* and *Furcocercaria A. Szidat* only in *L. palustris.*

As far as I can see, there is only one of two possibilities: either the eight different Miracidia when hatched from the eggs have entered at hazard the seven molluscs present in the ditch, whereupon the development has been stopped in all except a single species; or the Miracidia have been attracted by a single species only, whereas the others have had no attractive possibilities.

On reviewing the investigations, I cannot but think that they have hitherto pointed more in the direction of a predilection of the Miracidia for a special host than the reverse. It is quite another thing that driven by necessity they may put up with new hosts and in new localities accustom themselves to them (*C. Fasciolae hepaticae*).

Turning now to the Cercariae, all authors seem to have arrived at the result that the predilection for individual species is by no means so strongly developed as is the case with the Miracidia. It would seem that the Cercariae are tied to special groups of animals, to molluscs, to Arthropoda, to fishes, to birds, or to mammals, but not to single species.

As far as I can see, the Cercariae may from a biological point of view, be divided into three main groups: 1) Those which enter directly into the final hosts (*Schistosomatidae, Sanguinicolidae*) 2) those which encyst in the open on plants and leaves, and 3) those which encyst in a secondary host.

Of the first group the *Schistosomatidae* are limited to warm-blooded animals, the *Sanguinolidae* to fishes, and the *Spirorchidae* to turtles. The second group of course shows no predilection at all, and the next host in which they arrive with the food is the final one. The last group uses either one auxiliary host in which it encysts (*Echinostomatidae, Xiphidiocercaria*) or two, one in which it encysts and another in which it develops a new larva stage (*Tetracotyle, Diplostomum*) not attaining maturity before this second auxiliary host is devoured by a rapacious animal. There is some reason to believe that these species use two auxiliary hosts. In some cases this development may be curtailed, the host in which encystation takes place being the final one, but on that point investigations are greatly needed. In this connection stress need merely be laid on the fact that the first auxiliary host must be one which is eaten by a secondary one; it must belong to its regular diet if the development is to reach its final stage. As most of the animals living upon animal food have a very mixed diet, it is in good accordance with this fact that encystation may take place in animals belonging to very different parts of the main groups, to which the parasites appear to be adapted. Experiments would seem to show that Cercariae which encyst in fishes cannot encyst in molluscs or in Arthropoda etc. but on that point too investigations are highly needed.

During my own investigations in the laboratory, when I have been trying to infect other organisms not with Miracidia but with Cercariae for encystment I have always seen that either the Cercariae show complete apathy towards the organisms or the moment an animal is put into the vessel, they so to speak dart at it and, if it is not removed, cause its death in the course of some hours. Many authors have arrived at the same result.

The more the investigations appear to show that the Miracidia show predilection for species and the Cercariae for special groups of animals: snails, insects, fishes, amphibia, the more difficult it seems to understand by what means the Miracidia and Cercariae in the course of few hours reach the right host. In this connection it must in the first place be remembered that as a rule there is an enormous aggregation of animals on warm sunny days in the littoral zone of our ponds. A series of authors have tried to contribute to the solution of the question with regard to the Cercariae: Wunder (1923 a, p. 68), Faust and Meleney (1924), Szidat (1924, p. 249), Miller and McCoy (1930, p. 185), Miller (1929, p. 36), Miller and Mahaffy (1930, p. 95). All seem to arrive at the result that the Cercariae are not attracted chemically but by means of peculiarities in the swimming behaviour and by reactions particularly to shadowing. Thus Wunder has shown with regard to *Cercaria intermedia* and its intermediate host (*Corethra*) that photonegative reactions bring the species in connection with each other (see p. 89). Szidat shows with regard to his *Cercaria C.* that it reacts to stimuli of a phototactic and geotactic nature, but not to chemical ones. The Cercaria does not seek out its host, but stands awaiting it in a "Bereitschaftsstellung"; Miller and McCoy show that the swimming upwards of the lophocercous *Cercaria floridensis* in response to shadow stimuli is a factor which brings them towards the surface; the

Cercariae are highly sensitive to shadows, and it was supposed that the Cercariae were activated by the shadows cast by fish swimming above them. In this way the Cercariae were brought into the immediate neighbourhood of the fish, and thus the infestation was brought about. MILLER and MAHAFFY arrived at the same result with regard to a Furcocercaria, *C. hamata*, but in addition they show that there is a dual mechanism in the response to shadow and to touch, because the Cercaria may be kept in almost continuous locomotion by touch stimuli whereas a relatively long interval must intervene between shadow stimuli to secure anything like a regular response. Perhaps it may further be permitted to call attention to a highly remarkable fact, which may be common to all organisms that pass through a complicated metamorphosis, viz. that the same species in its different stages of development, e. g. the Trematoda in their Miracidium and Cercaria stages, show very different and often opposite responses to external stimuli. The remodelling of the organism is not only a morphological but also a physiological and psychological one; but in our present stage of knowledge more cannot be said on that point.

As often stated in this work, in many cases a simplification of the development may take place.

It is especially among the *Furcocercariae* which pass a *Tetracotyle* stage and among the *Echinostomes* and *Xiphidiocercariae* that we find examples of Cercariae which encyst in the same molluscs which they entered as a Miracidium. From my own observations I feel inclined to suppose that in that case we often have to do with phenomena which are due to bad life conditions, e. g. in aquaria, or to external conditions which prevent a normal development (desiccation of ponds, low temperatures causing freezing to the bottom of the ponds). A normal development with encystation in the same species in which the Miracidium has developed into a Sporocyst I think I have only seen in the Furcocercaria *Cercaria A. Szidat* but in this case, too, normally not in the same specimen. Especially the Xiphidiocercaria normally encyst in other organisms than snails, and only use snails if they are forced to do so and have no other choice. With regard to *C. echinata* my observations from Torkeris Pond appear to show that, whereas the development of parthenitae takes place in *Limnaea stagnalis*, the encystation takes place in *Planorbis corneus;* if further investigations should show that this is correct, we should here have an example of a species which as Miracidium and as Cercaria showed a predilection for two different snails.

I suppose that it is just this phenomenon, encystation in an abnormal host or an abnormal prolongation of the sojourn in a normal host, which causes the progenesis: the phenomenon that Trematoda produce eggs in the last larva stage. I here refer the reader especially to DOLLFUS (1924, p. 305; 1929, 1932, p. 407) and to WISNIEWSKI (1933, p. 259) who describes cysts with Metacercariae and eggs in the cysts. I confess that I have searched for these phenomena without success in the many thousands of cysts which I have found in many different snails.

4. *The Economic Significance of the Interplay between Trematoda and Molluscs.*

It may be regarded as an established fact that between the mollusc fauna and fish fauna of almost every water-body, a lake, a pond or a stream, and the Trematode fauna of the given locality there is an uninterrupted interplay.

In every pond, lake or stream where molluscs and fish occur, the circulation goes on; each locality has its own; this again differs not only from century to century, but also from year to year, the amount of variation being in inverse proportion to the size of the locality; the smaller the latter is, the greater is the variation. When the continuity of the circle is broken, when a species of snails becomes extinct, when a bird species which is a common visitor disappears from the water-body, the whole circle may run the risk of being broken down.

In very many cases this interplay between molluscs and fishes touches the interests of man. Of course this is chiefly the case when man is used as the final host in which maturity is attained. This is the case for instance with the Chinese liver fluke *Clonorchis sinensis* which in certain districts near Canton and above Swatow has parasitised up to 90 or even a 100 per cent of the population, and where the infection can beyond all doubt be referred to the Chinese habit of eating raw fish; human latrines were found directly over the fish ponds (Faust 1927b, p. 35; Faust and Khaw 1927, p. 147). A similar example is the infection by *Paragonimus Westermanni* in the Japanese population by the eating of crayfish infected with cysts upon the gill filaments and in all soft parts (Faust 1930, p. 220). It is highly probably that in many cases, especially in the tropics, the native habit of eating raw fish causes infections of different kinds of which hitherto we have known little or nothing at all. See also Tubangui and Pasco (1933, p. 581).

In another case the interplay between molluscs and fishes enters into the human sphere of interest as causing a diminution in the production of fish meat either by producing disease or death in the stock of fish or in diminishing its value as marketable goods. —

Perhaps it was first in the aquaria that the death of fish caused by Cercariae thrown out from snails was observed as a common phenomenon (Blockmann 1910, p. 47; Roth 1904, p. 41). Later on it has often been either presumed or directly observed in nature (Szidat 1927a, p. 83; Szidat 1927c, p. 245; Otterstrøm 1915, p. 221 and others).

Without going into detail there is no doubt that in the world-wide economy of freshwater fishes the molluscs play a rôle which can hardly be overrated. I refer here especially to Baker's very instructive paper on the relation of Molluscs to Fish in Oneida Lake (1916, p. 1). Further it must be remembered that not only may the life of the fish be threatened by Trematode attacks and now and then a general destruction of the fish in the water-body be the consequence, but the Trematoda may also be of economic significance in other respects. It may be regarded as an established fact that strong parasitic infection may produce retardation of early growth, retention of juvenile characters and an increase in the number of scales. I refer the reader especially to the papers of Hubbs (1928, p. 75) and Baker (1928, p. 494); the last-named author points out in addition that the fishes may be so strongly infected with cysts that they look pigmented, and as wormy and grubby have no more commercial value.

Now, since it is known that the infection of fish with Trematoda takes place precisely from Molluscs, it is no wonder that proposals have been made for the eradication of Molluscs wherever freshwater fish are subject to intensive economic output. Chandler (1920, p. 193).

In my opinion all proposals in this direction are just as onesided as in the long run they will prove extremely uneconomical. All who with regard to lakes and ponds wish to resort to remedies of such a radical nature have no idea of the inter-relationships of the inhabitants of water-bodies, the ever-existing interplay between the organisms which, especially in localities of so restricted a nature as a lake, a pond, or a stream often is, is so finely adjusted that one link in the chain cannot be removed without running the risk of rupture and often just where we would not wish it, and where oeconomic losses are the result. Quite apart from the danger of eradicating by means of chemicals a group of animals which enters into the food-economy of fishes, it must be remembered that the Molluscs, owing to the number of species and specimens, almost everywhere play a very great role in the common economy of the water-body; they are one of those factors which to some extent determine the amount of chalk in solution in the water; to a very great extent they determine the amount of lime deposits of the lake, they are among the most important factors with regard to destruction of the living plant material, as well as of decaying material. The bottom of our bays is in the autumn regularly covered with a grey layer of snail excrements. Quite a part from the fact that chemicals, of whatever nature they be, if they will kill the molluscs, will most probably be detrimental to numerous other organisms, especially to the vegetation, an eradication of the Molluscs in water-bodies will totally alter the character of the water. In my opinion the eradication will only be warrantable in the case of artificial fish ponds, and here we may hope to obtain a good result (Baker 1922, p. 145).

Recent investigations have further shown that our ducks and our poultry are infected by Trematoda which they get during their sojourn in the duck-ponds or when eating insects which carry cysts of Trematoda derived from the lower fresh-water fauna.

Szidat (1927b, 1930a, p. 105) has shown that the monostome *Cercaria ephemera* which develops in *Planorbis corneus* when transferred as cysts into the alimentary canal of our ducks in the appendices of the birds develops into *Catatropis verrucosa*. It lives here in company with species of the nearly related genus *Notocotylus*.

Szidat (1927b, 1929b, p. 78) has further shown that all the observed specimens of *Anas crecca* and *Anas boshas* from Kurische Nehrung were infected with *Bilharziella polonica* and that the ducks also harboured the parasite in great numbers. In both cases Szidat maintains that little harm seems to be done by the parasite.

Of the *Echinostomes Hypoderaeum conoideum* seems normally to parasitise our ducks (Nøller und Wagner 1923, p. 463), *Echinoparyphium recurvatum* (v. Linst.); ducks and fowls (Bittner 1925, p. 82).

Another duck parasite is the Holostome *Apatemon gracile* belonging to the subfamily *Strigeinae*, which develops from *Tetracotyle* developing in the intermediate host, the Hirudinea: *Herpobdella atomaria* (Szidat 1931 b, p. 160). Real damage is caused by the *Prosthogonimus pellucidus* which is found in the oviduct of our poultry and makes the fowls lay wind-eggs. Already Weltner (1896, p. 199) found cysts in *Libellulidae*. Hieronymi and Szidat (1921); Seifert (1923, p. 541; 1924, p. 75); de Blieck and Heelsberger (1923, p. 13); Bittner (1923, p. 503 and 1927, p. 213) and Otte (1926, p. 444) described the disease, but it was Szidat (1928 c, 1931 a, p. 289), who showed that the fowls were affected after eating either the larvae or the newly hatched *Libellulidae* (*Cordulia aenea*). In the pond 74 of 100 larvae contained cysts. There is no doubt that in this parasite we have a foe to our poultry whose influence cannot be overrated.

As far as I know, investigations on the Trematode-infected ducks and poultry have not been carried out in our country; we have only accounts according to which ducks get sick when put into certain ponds; furthermore when some of a flock are brought to the ponds and others kept away from it, the former will be affected, the latter not. A closer examination, in our country also, would undoubtedly be desirable.

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EXPLANATION OF THE PLATES

Plates 1—35 are all drawn by myself. The drawings are nearly all camera-drawings. Microscope: Zeiss. They are worked out and drawn from living animals, and very often the final drawings are combined from several special drawings. The plates are reduced to $^{2}/_{3}$; only figures Pl. XI, fig. 3, Pl. XXI, fig. 1, Pl. XXIII, fig. 3, Pl. XXVII, fig. 1 are reduced to $^{1}/_{2}$.

The microphotos shown in Plates XXXVI—XXXIX have been taken by Dr. Berg.

Plate I.

Monostomata.

Fig. 1.	*Cercaria ephemera* Nitzsch......	*Planorbis corneus*	Furesø..........	28/IV 32	Oc. 2	Obj. 4
- 2.	—	—	The moor Hillerød	17/IV 31	- 4	- 16
- 3.	—		—	17/IV 31	- 4	- 16
- 4.	—	*Planorbis vortex* . .	Vixømoor	20/VII 31	- 2	- 4
- 5.	—	— . .	—	20/VII 31	- 4	- 16
- 6.	— Redia.......	— . .	—	20/VII 31	- 4	- 16
- 7.	— —	— . .	—	20/VII 31	Sucheroc.	- 16
- 8.	— — ; the same specimen drawn in the course of five minutes.......	— . .	The moor Hillerød	17/IV 31	Oc. 4	- 16

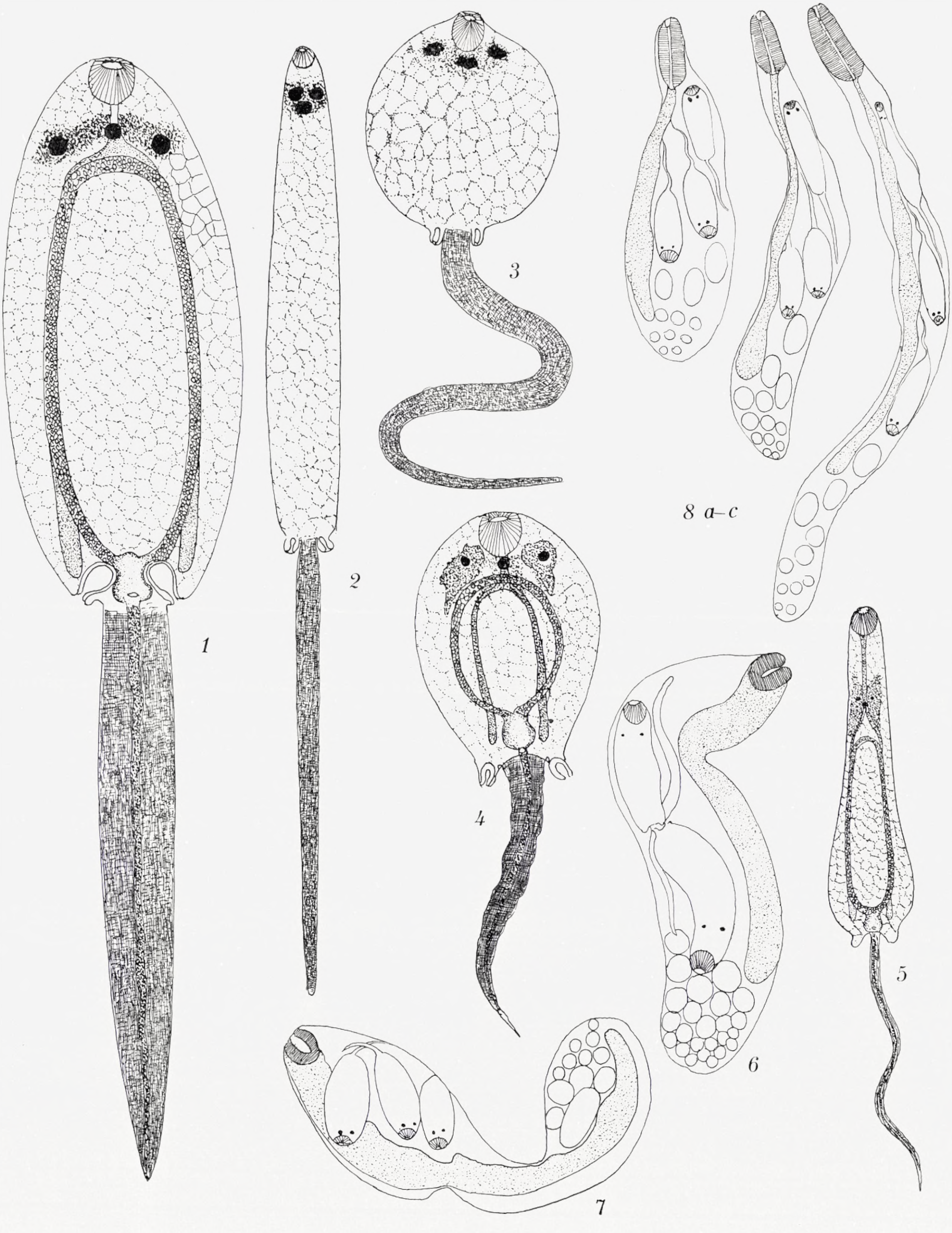
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Plate II.

Monostomata.

Fig. 1.	*Cercaria monostomi*	*Limnaea stagnalis*	Tjustrup Lake	15/V	31	Oc. 2	Obj. 4
- 2.	— Redia	—	—	15/V	31	- 4	- 16
- 3.	— Redia: The hold fast organ	*Limnaea ovata*	—	25/V	31	- 4	- 16
- 4.	— Redia. Posterior part	*Limnaea stagnalis*	—	25/V	31	- 2	- 4
- 5.	*Cercaria imbricata*	*Bithynia tentaculata*	Hellebæk	29/V	31	- 4	- 4
- 6.	— Redia	—	Værebroaa, Hillerød	17/VII	31	- 4	- 4
- 7.	— Redia	—	Næsbybro, Sorø	10/VIII	31	- 2	- 4
- 8.	— Redia	—	Værebroaa, Hillerød	17/VII	31	- 6	- a*
- 9.	— Redia	—	Bromme Lake, Sorø	27/X	32	- 4	- 16
- 10.	— Redia, gut turned inside out	—	Hellebæk	29/V	31	- 4	- 4
- 11.	— Cyst: part of the wall	—	—	29/V	31	- 4	- 4

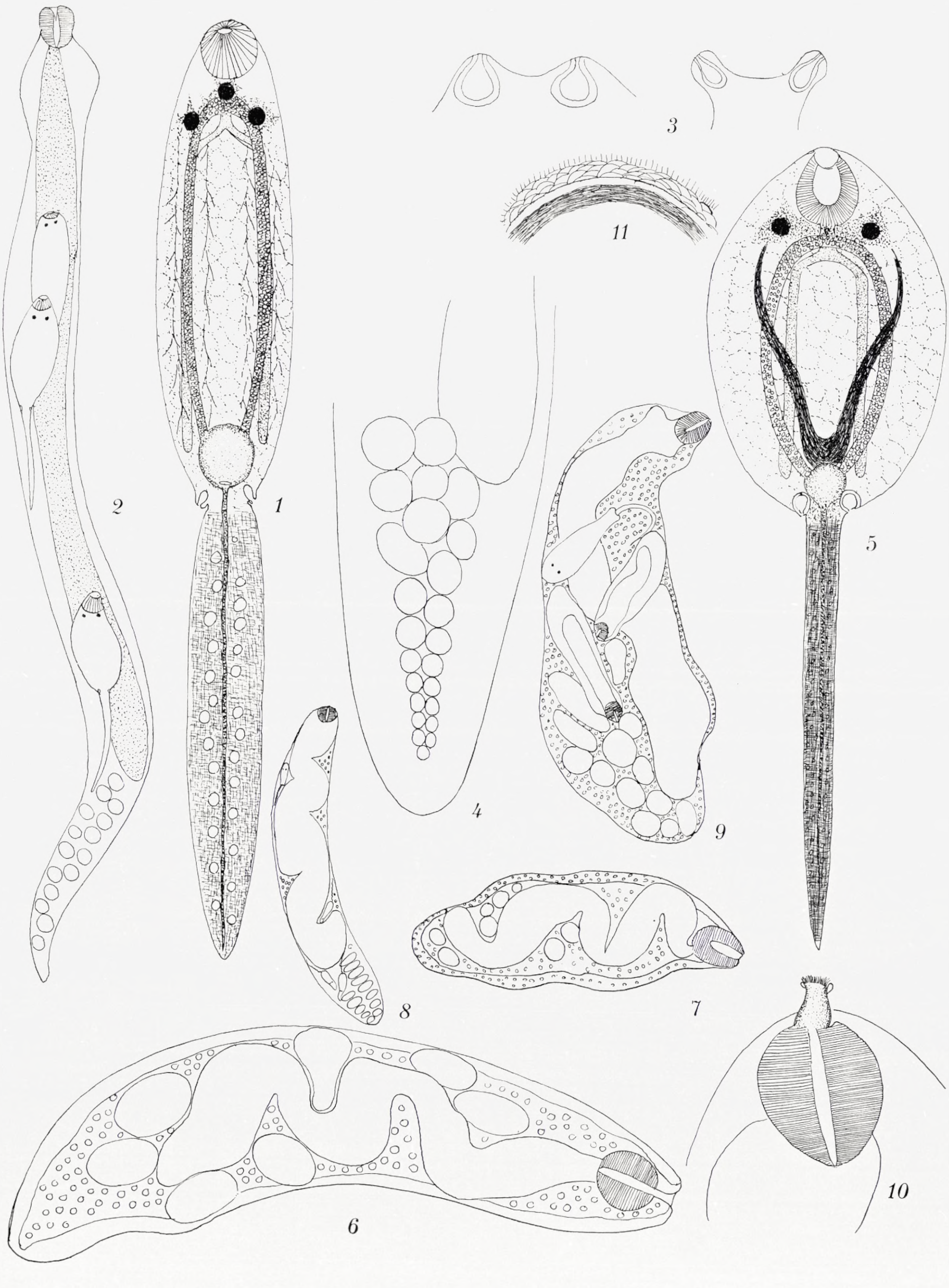
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Plate III.

Amphistomata.

Fig. 1.	*Cercaria diplocotylea*	*Planorbis umbilicatus*	Regnstrup, Sorø	14/VIII 32	Obj. 4 Oc. 16
- 2.	— The same animal drawn in the course of 5 min.	—	—	14/VIII 32	
- 3.	*Cercaria diplocotylea.* The peculiar picture of a swimming Cercaria. With incredible speed the tail is lashed laterally from the left to the right and then forward in the same manner. The observer receives the impression of two bows, of which the posterior one is always the most conspicuous; the anterior one less marked	—	—	14/VIII 32	
- 4.	*Cercaria diplocotylea.* Redia	—	—	14/VIII 32	- 2 - 16

Gymnocephala.

Fig. 5.	*Cercaria tuberculata*	*Bithynia tentaculata*	Donse, Hillerød	9/VII 31	Obj. 4 Oc. 4
- 6.	— Young Redia	—	—	9/VII 31	- 4 - 4
- 7.	— Newly hatched Redia ..	—	—	9/VII 31	- 4 - 4
- 8 a—c.	— The same Redia, drawn in the course of 5 min.	—	—	9/VII 31	
- 9.	— Cyst	—	—	9/VII 31	- 2 - 4

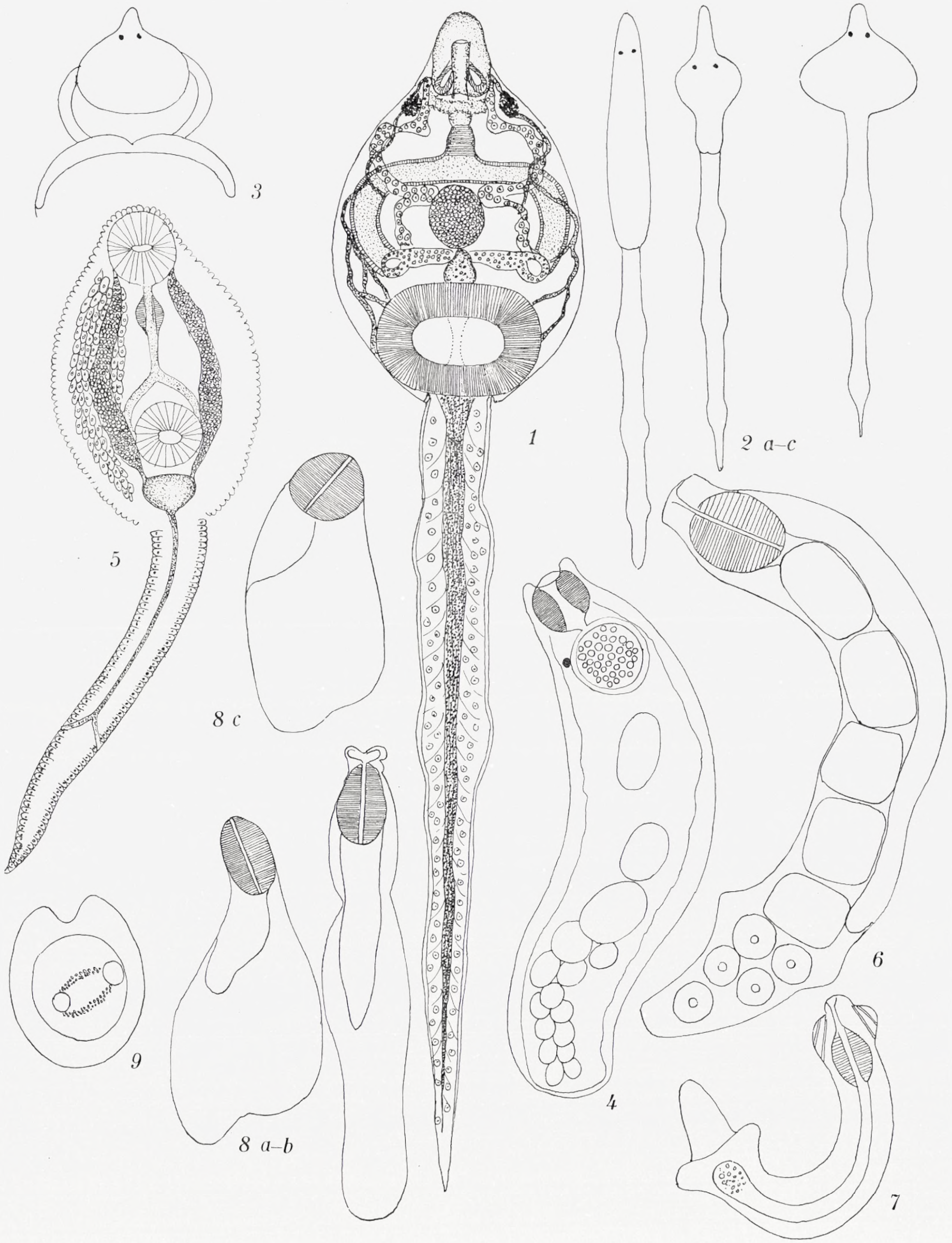
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Plate IV.

Gymnocephala.

Oc. 4 Obj. 16.

Fig. 1.	*Cercaria papillosa*	*Bithynia tentaculata*	Hellebæk	23/V 31
- 2.	— lateral view	—	—	23/V 31
- 3.	— Redia	—	—	23/V 31
- 4.	— Redia	—	Furesø	13/V 32
- 5.	— Redia	—	—	13/V 32
- 6.	— Redia	—	—	13/V 32
- 7.	— Redia	—	—	13/V 32
- 8.	— Redia	—	—	13/V 32
- 9.	— A very old Redia	—	—	13/V 32
	Figs. 5—9 illustrate how the Redia contains the nutritive organ in an anterior part while a posterior part contains the brood.			
- 10.	*Cercaria papillosa*. Very young Redia	—	—	13/V 32
- 11.	— Very young Redia	—	—	13/V 32

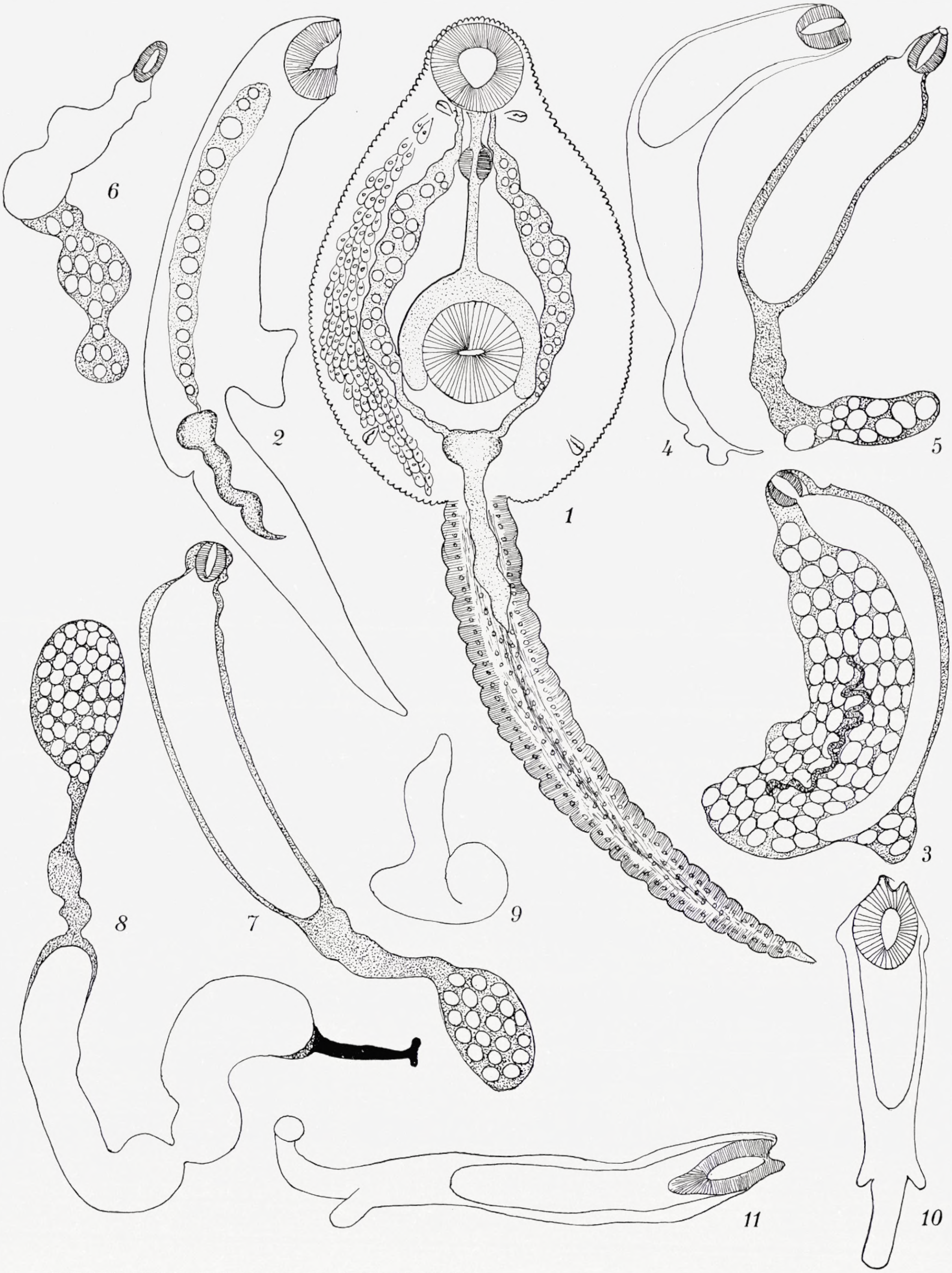
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Plate V.

Gymnocephala.

Fig. 1.	*Cercaria helvetica XIX* Dubois . . .	*Bithynia tentaculata*	Værebroaa, Hillerød	19/VII 31	Oc. 4	Obj. 4
- 2.	— Redia	—	—	19/VII 31	- 4	- 4
- 3.	— Redia	—	—	19/VII 31	- 4	- 4
- 4.	*Cercaria grandis* n. sp.	—	Ramløseaa, Hillerød	13/VII 31	- 4	- 4
- 5.	— Redia	—	—	13/VII 31	- 4	- 16
- 6.	— Redia	—	—	13/VII 31	- 2	- 16
- 7.	*Cercaria obscura* n. sp., contracted	—	Furesø	16/IX 31	- 4	- 4
- 8.	— extended .	—	—	16/IX 31	- 4	- 4

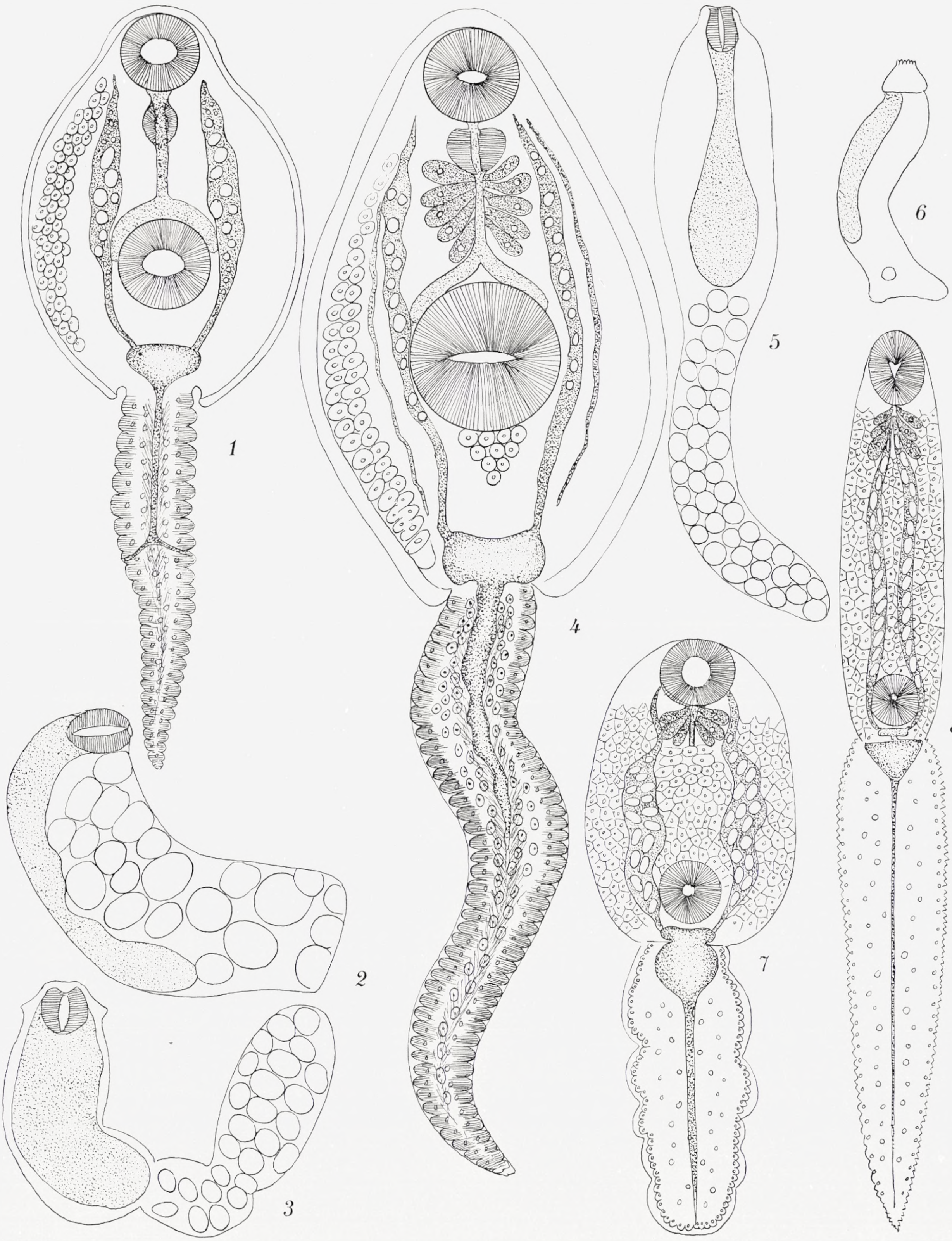
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Plate VI.

Gymnocephala.

Fig. 1.	*Cercaria obscura* n. sp.	*Bithynia tentaculata*	Furesø	16/IX 31	Oc. 4	Obj. 4
- 2.	— Redia newly born	—	—	16/IX 31	- 4	- 4
- 3.	— Redia very old	—	—	16/IX 31	- 2	- 4
- 4.	— Redia with Tetracotyle	—	—	16/IX 31	- 2	- 4
- 5.	— Redia, the same specimen drawn in the course of 5 minutes	—	—	16/IX 31		
- 6.	*Cercaria lophocerca*	—	Susaa, Sorø	3/VIII 31	- 6	- 16
- 7.	— Redia	—	—	3/VIII 31	- 6	- 16
- 8.	— Redia	—	—	3/VIII 32	- 6	- 16
- 9.	Redia sp.	—	Castle Park, Hillerød	1/VIII 32	- 2	- 4
- 10.	—	—	—	1/VIII 32	- 2	- 16
- 11.	— very young	—	—	1/VIII 32	- 2	- 4

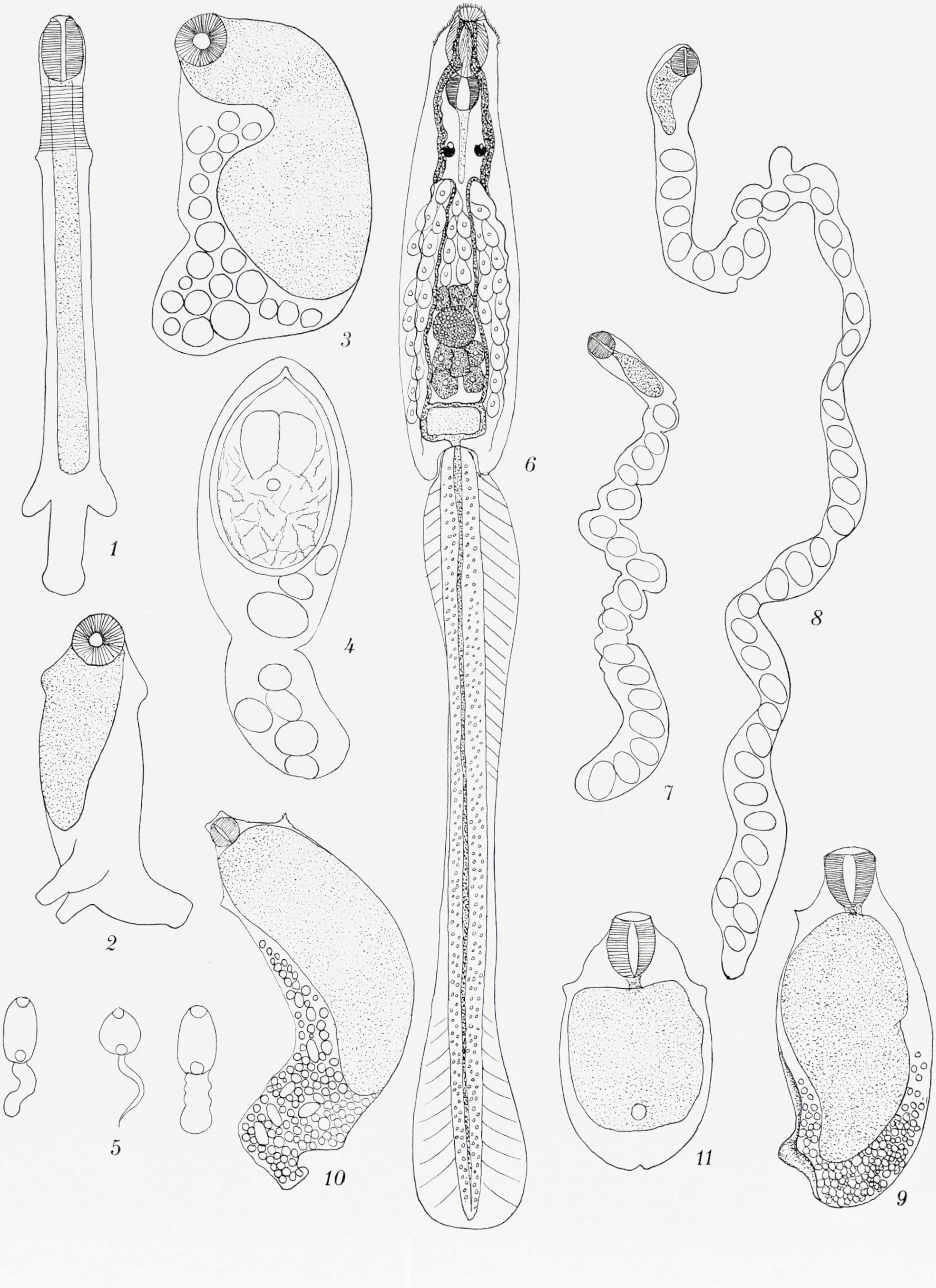
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Plate VII.

Echinostomata.

Fig. 1.	*Cercaria echinatoides* Corona	*Paludina vivipara*	Hellebæk	2/III 32	Oc. 6	Obj. a*
- 2.	— Redia	—	—	2/III 32	- 2	- 16
- 3.	*Cercaria echinostomi*	*Limnaea palustris*	Bromme	1/VIII 31	- 2	- 4
- 4.	— Redia	—	—	1/VIII 31	- 6	- a*
- 5.	*Cercaria abyssicola* n. sp.	*Valvata piscinalis*	Tjustrup Lake	30/VII 31	- 4	- 4
- 6.	— Lateral view of the tail showing the fin fold	—	—	30/VII 31	- 4	- 4
- 7.	— Redia very young	—	—	30/VII 31	- 4	- 4

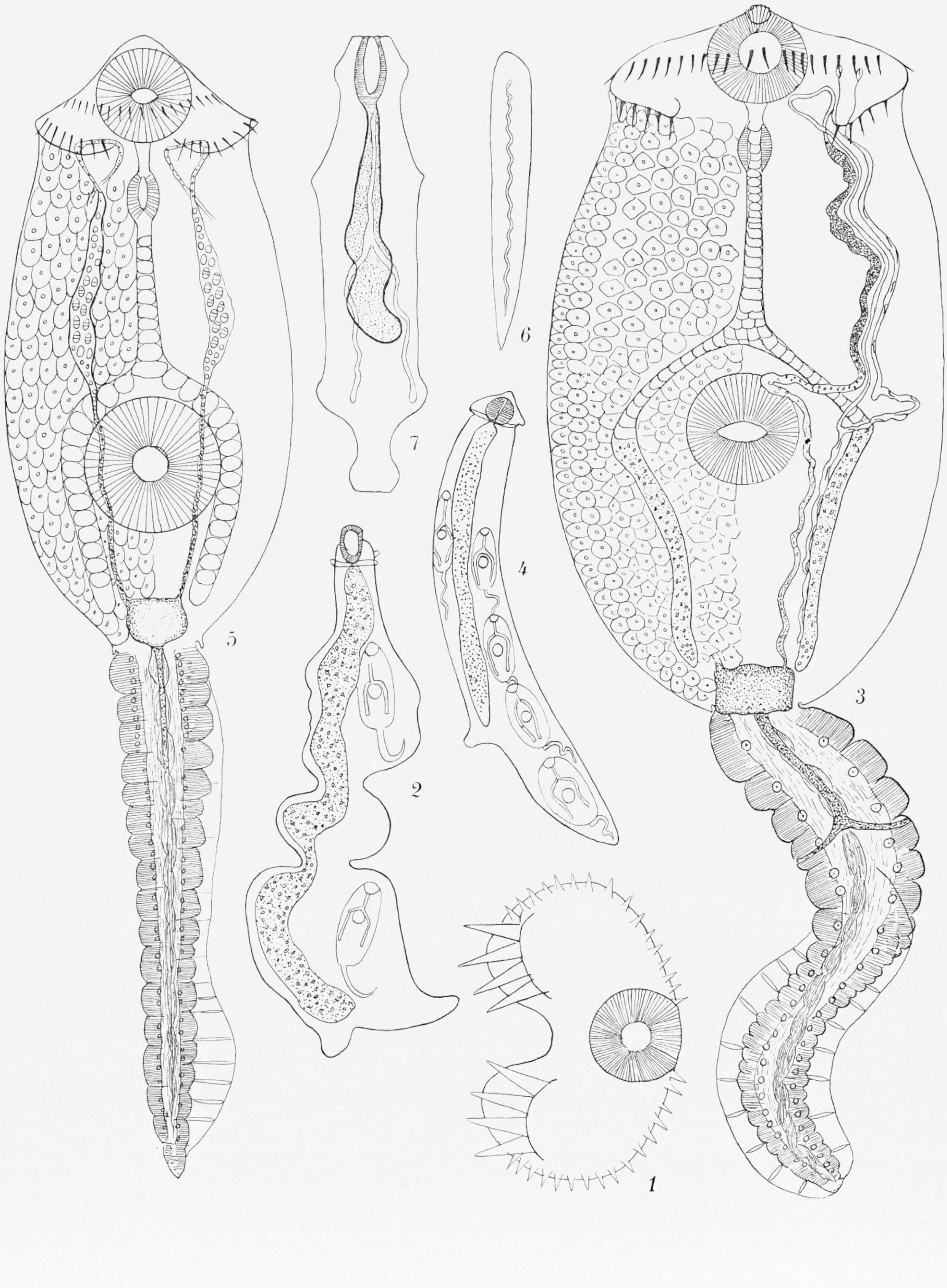
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Plate VIII.

Echinostomata.

Fig. 1.	*Cercaria echinoparyphii recurvatum*	*Planorbis umbilicatus*	Furesø	25/IV 32	Oc. 2	Obj. 4
- 2.	— Redia	—	—	25/IV 32	- 2	- 16
- 3.	— Forepart of the Redia	—	The moor, Hillerød	12/III 32	- 2	- 16
- 4.	— Very young Redia	—	—	12/III 32	- 4	- 16
- 5.	— Fig. 5, still in the mother Redia	—	—	12/III 32	- 4	- 16
- 6. - 7. - 8.	— Cysts	—	—	12/III 32	- 4	- 4
- 9.	*Cercaria spinifera*	*Planorbis corneus*	Torkeris Pond, Hillerød	6/V 31	- 2	- 4
- 10.	— Redia	—	—	6/V 31	- 4	- 16
- 11.	— Redia	—	—	6/V 31	- 2	- 16
- 12.	— Forepart of a Redia	—	—	6/V 31	- 6	- 16
- 13.	— Redia	—	The moor, Hillerød	6/V 31	- 2	- 16
- 14.	— Redia	—	—	6/V 31	- 2	- 16
- 15.	— Redia	—	—	6/V 31	- 2	- 16
- 16.	— Redia	—	Torkeris Pond, Hillerød	7/V 31	- 6	- a*
- 17.	— Liver of the *Planorbis* with a great mass of cysts at the base	—	—	7/V 31		

Plate VIII

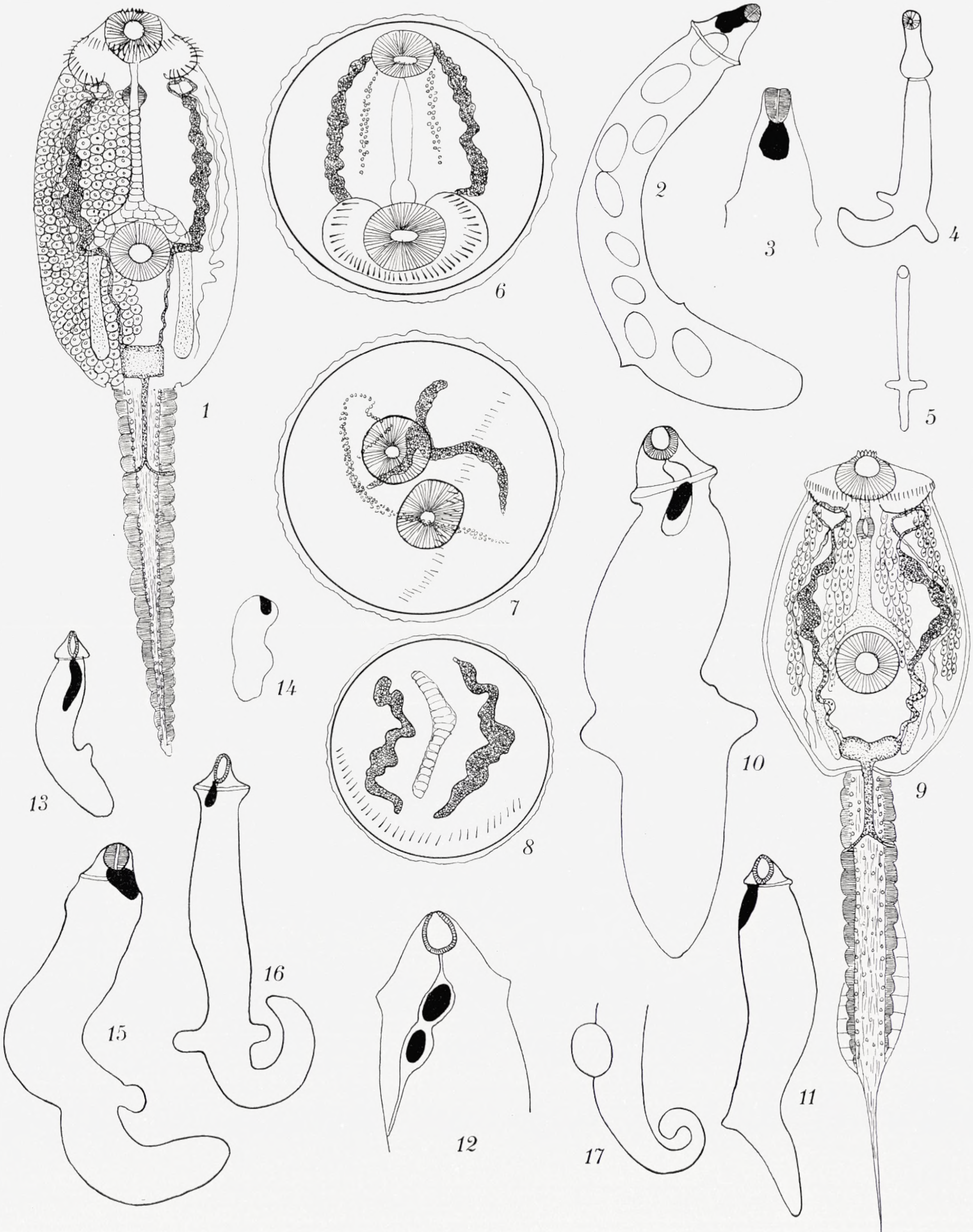

Plate IX.

Echinostomata.

Fig. 1.	*Cercaria echinata*	*Limnaea stagnalis*	Torkeris Pond, Hillerød	23/IV 31	Oc. 2	Obj. 4
- 2.	— Redia with Cercariae	—	—	25/V 31	- 4	- 16
- 3.	— Redia of peculiar form	—	—	25/V 31	- 6	- a*
- 4.	— Redia of peculiar form	—	—	8/V 31	- 6	- a*
- 5.	— Redia with daughter rediae	—	—	3/V 31	- 6	- a*
- 6.	— Old Rediae of peculiar form	—	—	6/VII 31	- 8	- a*
- 7.	— Old Rediae of peculiar form	—	—	30/IV 31	- 4	- a*
- 8.	— Old Rediae of peculiar form	—	—	30/IV 31	- 4	- a*
- 9.	— Old Rediae of peculiar form	—	—	30/IV 31	- 4	- a*
- 10.	— Old Rediae of peculiar form	—	—	30/IV 31	- 4	- a*
- 11.	— Old Rediae of peculiar form	—	—	30/IV 31	- 2	- 16
- 12.	Redia with daughter redia, Cercaria and Tetracotyle	—	Spring pond	15/VII 32	- 6	- a*
- 13.	Redia with Cercariae; the excretory system very conspicuous	—	—	15/VII 32	- 2	- 16

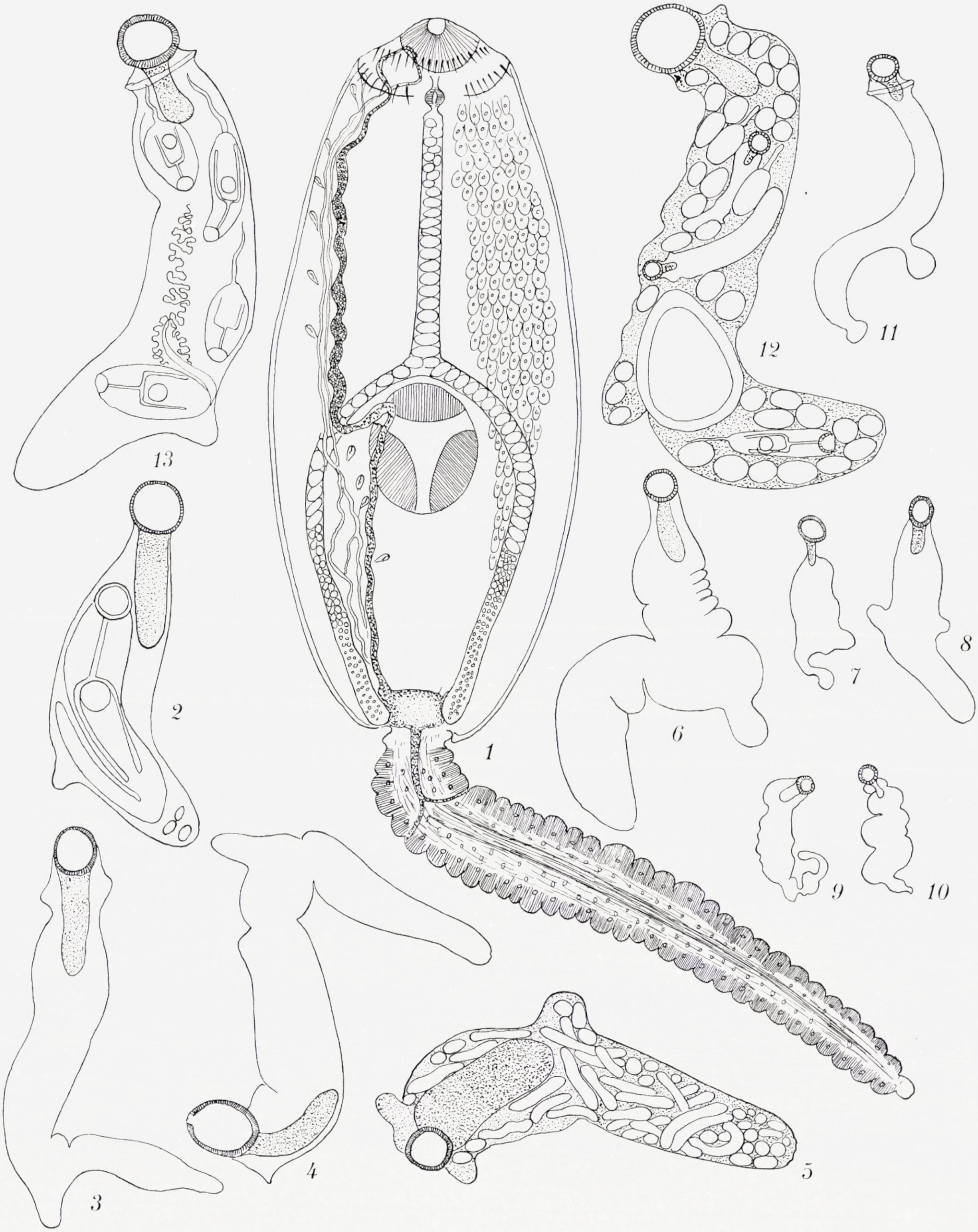
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Plate X.

Echinostomata.

Fig. 1.	*Cercaria echinata.* Redia	*Limnaea stagnalis*	Torkeris Pond, Hillerød	26/IV	32	Oc. 6	Obj. a*
- 2.	— Forepart of the Redia	—	—	26/IV	32	- 6	- a*
- 3.	— Redia	—	—	30/IV	32	- 2	- a*
- 4.	— Redia with daughter rediae, Cercariae and Tetracotyle	—	—	26/IV	32	- 6	- a*
- 5.	— Excretory system, Redia	—	—	20/IV	32	- 6	- IV
- 6.	— Redia which has just begun propagation ...	—	—	30/IV	32	- 4	- 16
- 7.–14.	Figs. 7—14 illustrate the encystation, vide the text ...	—	Strødam, Hillerød	15/II	33		
- 15.	Redia sp.	*Planorbis albus* ..	Castle Park, Hillerød ..	1/VIII	32	- 4	- 16

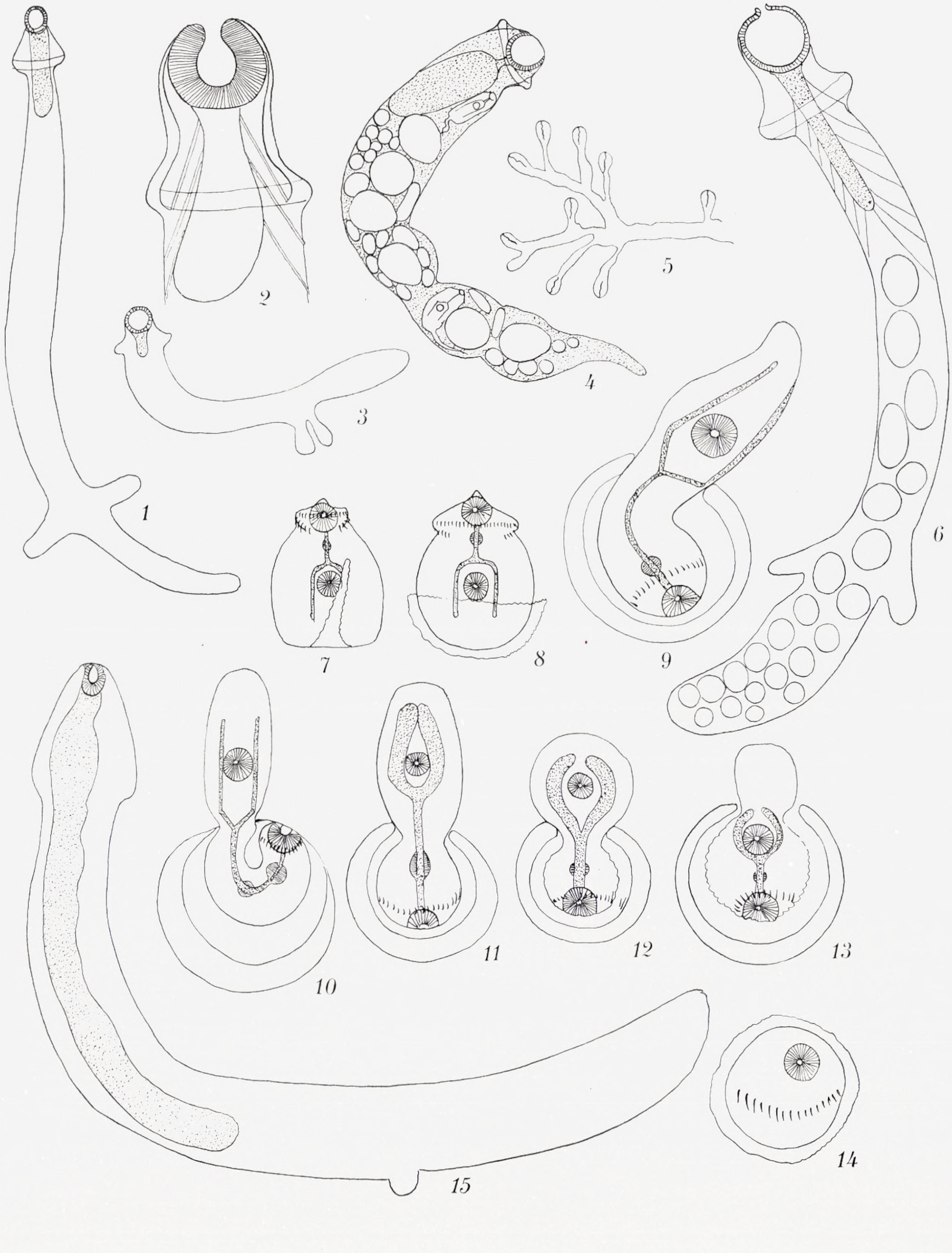
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Plate XI.

Echinostomata.

Fig. 1.	*Cercaria affinis* n. sp.	*Limnaea auricularia*	Susaa	2/VI 31	Oc. 2	Obj. 4
- 2.	— lateral view	—	—	2/VI 31	- 2	- 16
- 3.	*Cercaria Hypodereae conoideae*	*Limnaea ovata*	Donse, Hillerød	9/XI 31	- 4	- 4
- 4.	— Redia	—	—	9/XI 31	- 4	- 16
- 5.	*Cercaria coronata*. Redia	*Limnaea auricularia*	Susaa	9/VI 31	- 4	- a*
- 6.	*Cercaria Hypodereae conoideae*. Redia .	*Limnaea ovata*	Donse, Hillerød	9/XI 31	- 4	- 16


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Plate XII.

Xiphidiocercaria.

Oc. 4 Obj. 4.

Fig	1.	*Cercaria laticauda*	*Limnaea stagnalis*	Strødam	13/II 32
-	2.	— Sporocyst	—	—	13/II 32
-	3.	*Cercaria prima*	*Planorbis albus* ..	The Castle Pond, Hillerød	2/VIII 32
-	4.	— Sporocyst....................	— ..	—	2/VIII 32
-	5.	*Cercaria Limnaeae ovatae*	*Limnaea ovata*...	Strødam	
-	6.	— Sporocyst...............	— ...	—	

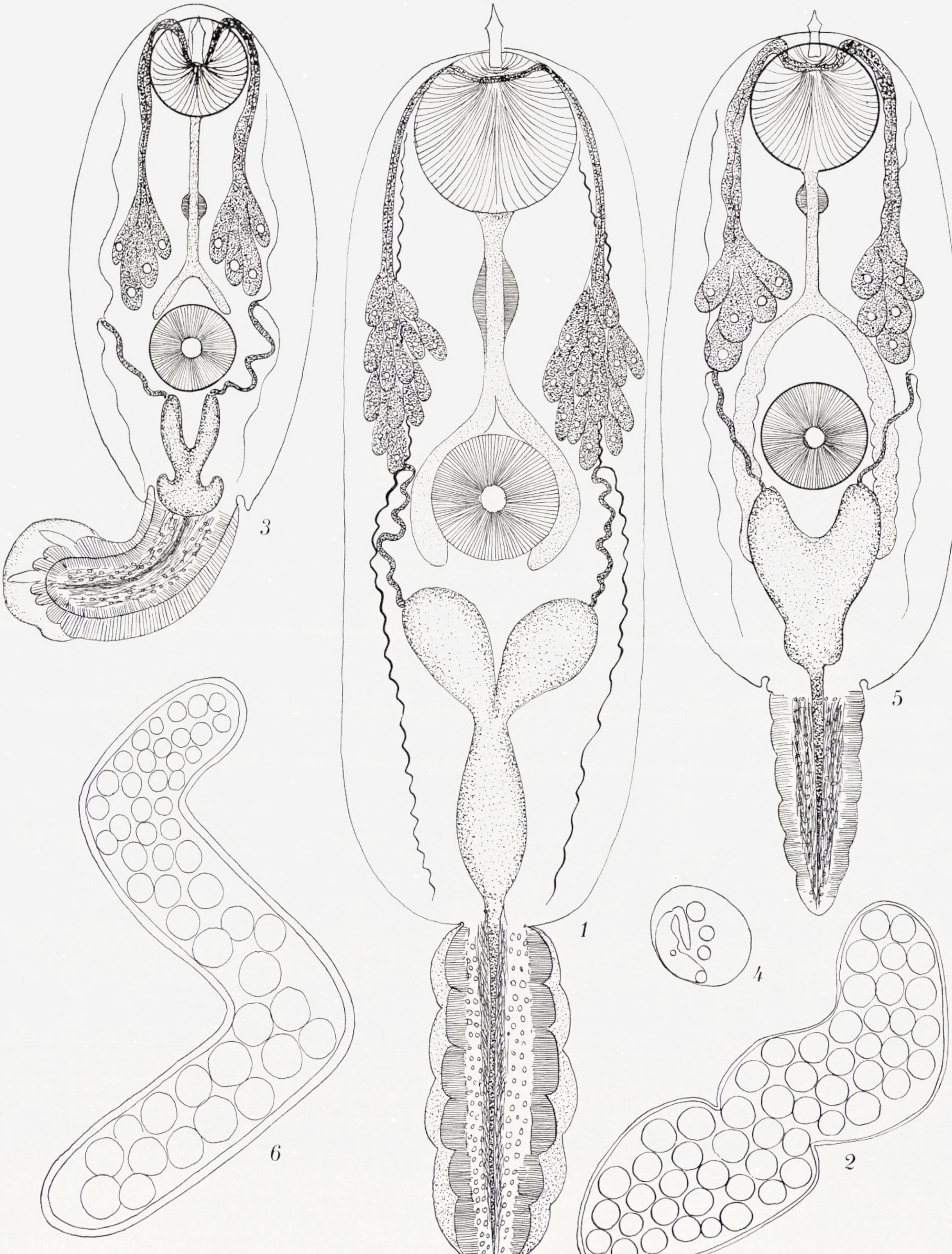
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Plate XIII.

Xiphidiocercaria.

Fig. 1.	*Cercaria Limnaeae ovatae.* Part of a segment of the Corethra larva with Cercariae entering the cuticula	*Limnaea ovata*	Strødam, Hillerød		Oc. 4	Obj. 16
- 2.	*Cercaria gracilis*	*Planorbis corneus*	Donse, Hillerød	6/XI 32	- 4	- 4
- 3.	— Stylet	—	—	6/XI 32	- 4	hom. Im
- 4.	— Sporocyst	—	—	6/XI 32	- 4	- a*
- 5.	— Sporocyst	—	—	6/XI 32	- 4	- a*
- 6.	*Cercaria Haplometrae cylindricae*	*Limnaea stagnalis*	The brick factory, Hillerød	19/V 31	- 6	- 4
- 7.	— Stylet	—	—	19/V 31	- 4	hom. Im
- 8.	— Part of a segment of the Corethra larva with Cercariae entering the cuticula	—	—	19/V 31	- 2	- 16
- 9.	— Cyst	—	—	19/V 31	- 4	- 4
- 10.	— Sporocyst	—	—	19/V 31	- 2	- 16

Plate XIII

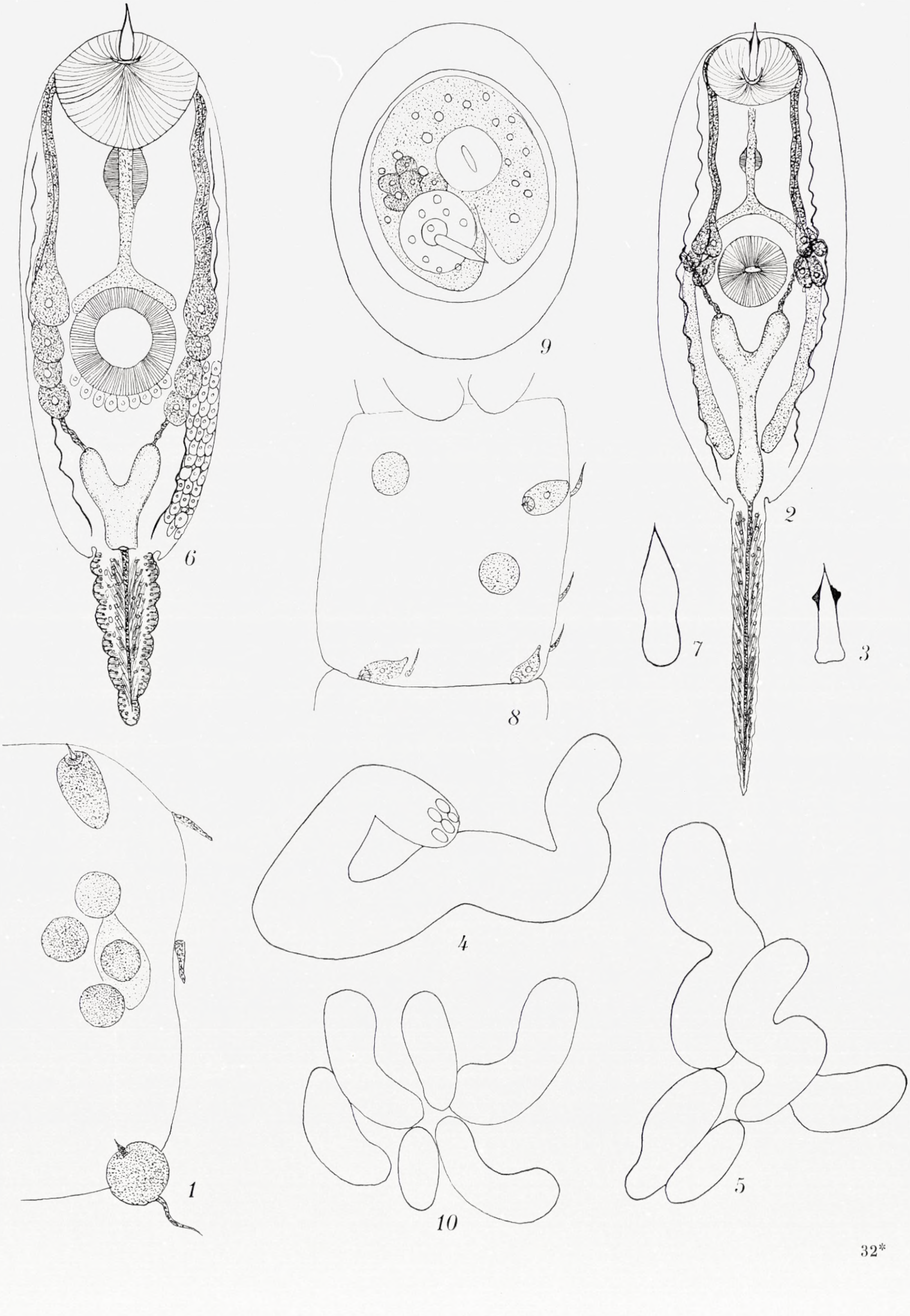

Plate XIV.

Xiphidiocercaria.

Fig. 1.	*Cercaria vesiculosa*, contracted	*Bithynia tentaculata*	Tjustrup Lake	8/VIII 32	Oc. 4	Obj. 4
- 2.	— extended	—	—	8/VIII 32	- 4	- 4
- 3.	— Sporocyst	—	—	8/VIII 32	- 2	- 4
- 4.	— Sporocyst with cysts and cercaria germs	—	—	8/VIII 32	- 4	- 4
- 5.	*Cercaria cellulosae*..................	*Paludina vivipara*..	Hellebæk	26/V 31	- 4	- 4
- 6.	— Sporocyst	— ..	—	26/V 31	- 4	- 16
- 7.	— Sporocyst with Cercariae between it and the paletot...	— ..	—	26/V 31	- 2	- 4
- 8.	— The cells of the paletot ...	— ..	—	26/V 31	- 6	- 4
- 9.	*Cercaria pusilla* Sporocyst...........	— ..	—	26/V 31	- 2	- 4
- 10.	— Sporocyst...........	— ..	—	26/V 31	- 2	- 4
- 11.	— Sporocyst...........	— ..	—	26/V 31	- 2	- 4
- 12.	— Sporocyst......... ..	— ..	—	26/V 31	- 2	- 4

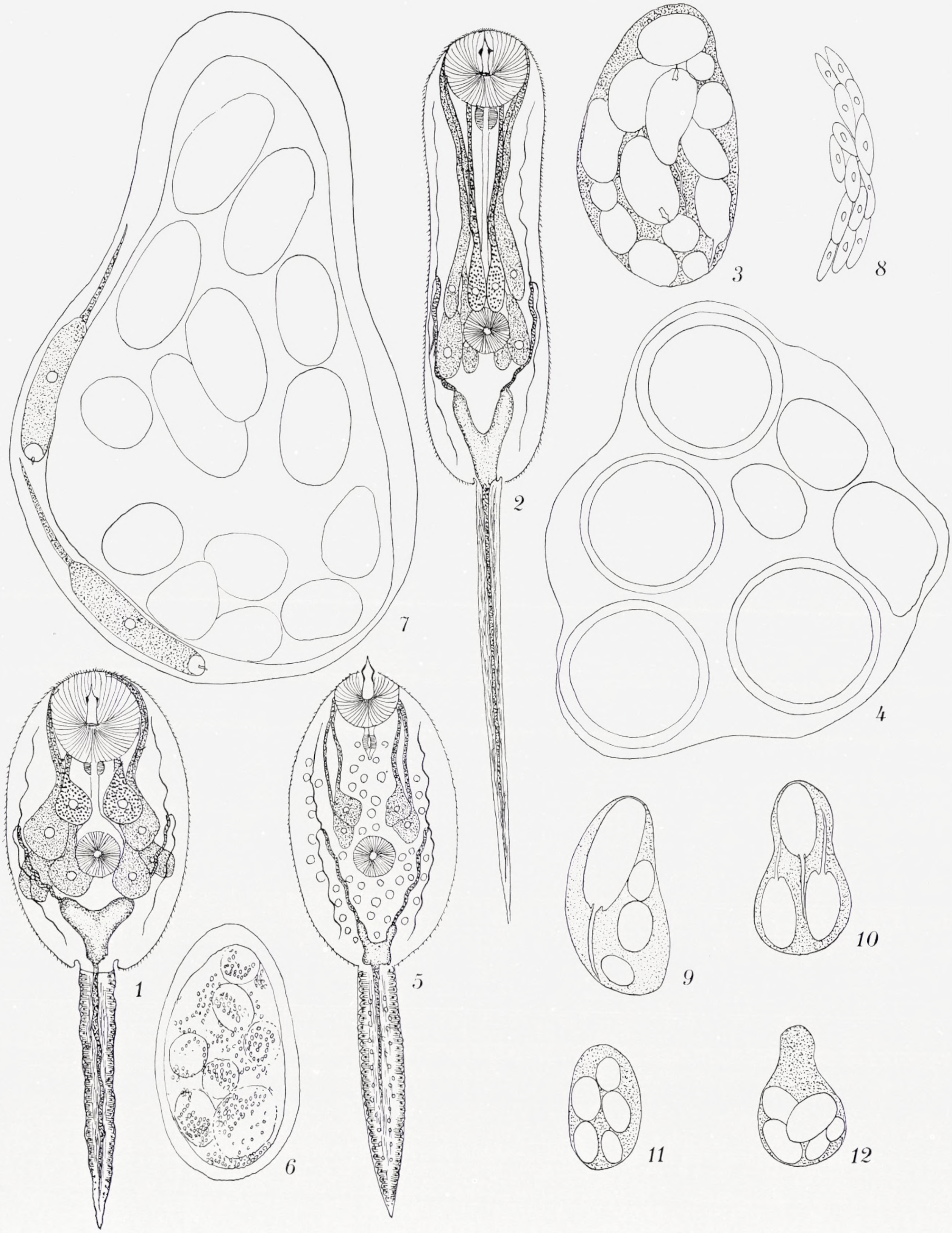
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Plate XV.

Xiphidiocercaria.

Fig. 1.	*Cercaria pusilla*	*Bithynia tentaculata*	Hellebæk	25/V 31	Oc. 6	Obj. 4
- 2.	— contracted	—	—	25/V 31	- 4	- 4
- 3.	— Part of the liver of the snail containing enormous numbers of sporocysts...............	—	—	25/V 31	- 4	- a*
- 4.	— Sporocyst	—	—	13/IV 31	- 4	- 4
- 5.	*Cercaria cordiformis* n. sp., contracted .	—	—	13/IV 31	- 6	- 4
- 6.	— fully extended.............	—	—	13/IV 31	- 6	- 4
- 7.	— The common form when swimming.................	—	—	13/IV 31	- 6	- 4
- 8.	— Sporocyst	—	Donse ..	10/VII 31	- 6	- 16
- 9.	— Sporocyst	—	Hellebæk	13/IV 31	- 6	- 16
- 10.	— Cyst......................	—	—	13/IV 31	- 4	- a*

Plate XV

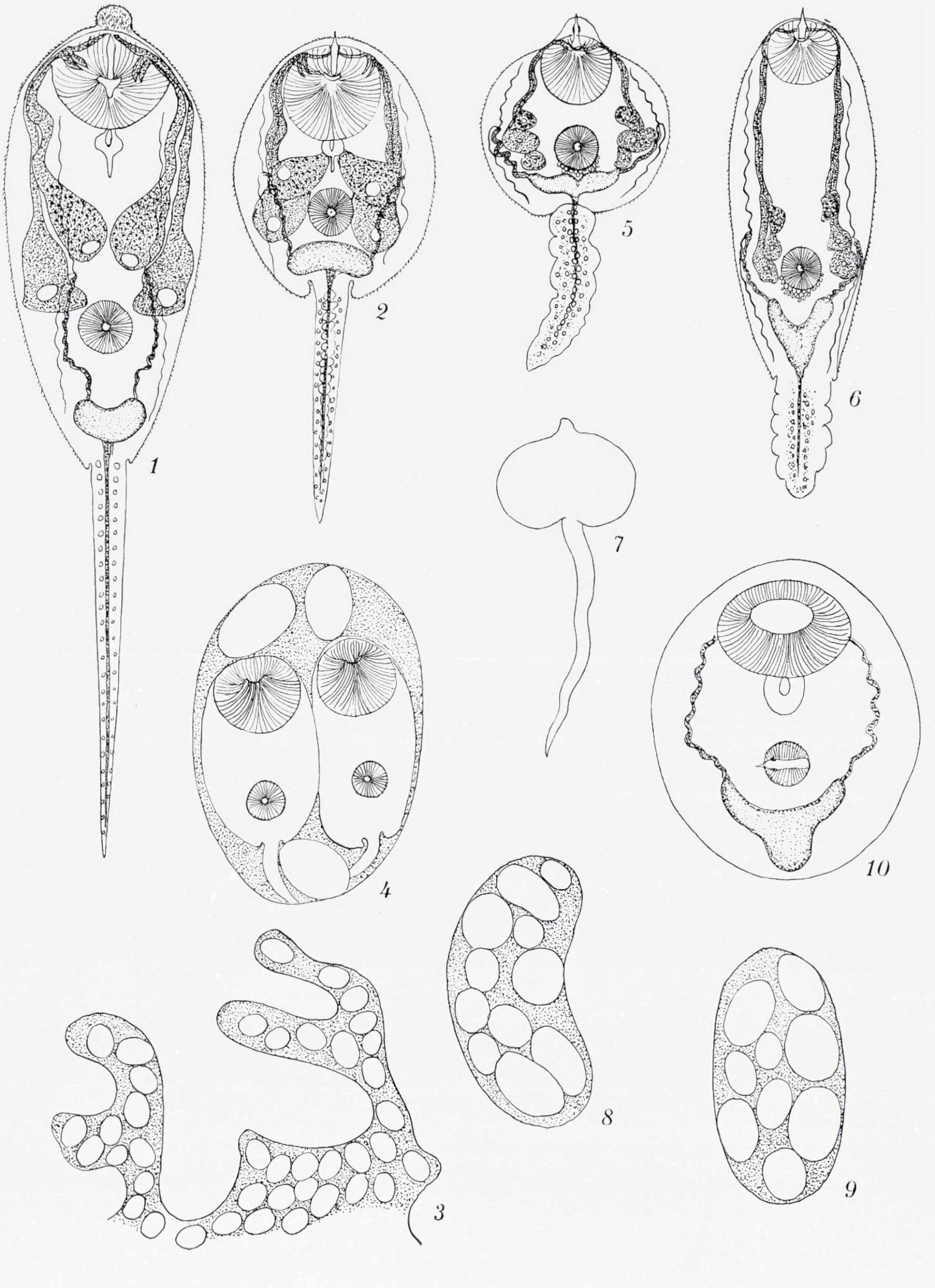

Plate XVI.

Xiphidiocercaria.

Fig. 1.	*Cercaria nodulosa*	*Bithynia tentaculata*	Hellebæk	2/IV 31	Oc. 4	Obj. Waterim.
- 2.	— expanded	—	—	2/IV 31	- 4	- Waterim.
- 3.	— Sporocyst	—	—	2/IV 31	- 6	- 16
- 4.	— Sporocyst	—	—	2/IV 31	- 4	- 4
- 5.	*Cercaria virgula*	—	Strødam, Hillerød	24/X 31	- 4	- 4
- 6.	— Sporocyst	—	—	24/X 31	- 4	- 16
- 7.	*Cercaria helvetica IX* Dubois	—	Værebro, Hillerød	17/VII 31	- 4	- 4
- 8.	— Sporocyst	—	—	17/VII 31	- 6	- 16

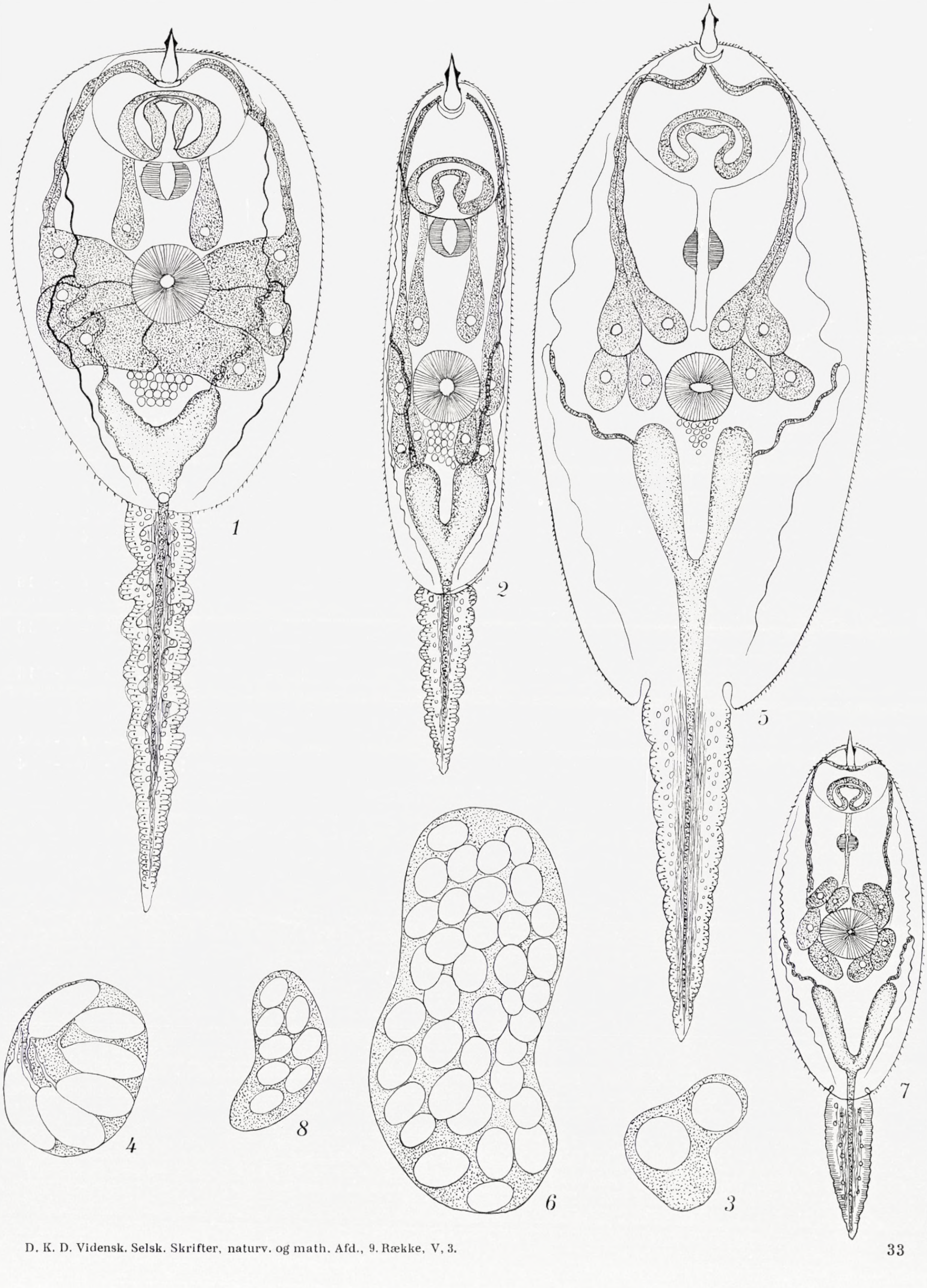
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Plate XVII.

Macrocercaria.

Fig. 1.	*Cercaria vitellilobae* in its house....	*Sphaerium corneum*	Strødam, Hillerød..	5/VI 31	Oc. 4	Obj. 16
- 2.	— halfway extended	—	— ..	5/VI 31	- 4	- 16
- 3.	— fully extended	—	— ..	5/VI 31	- 4	- 16
- 4.	*Cercaria Pagenstecheri.* Part of the tail; the musculature only drawn in the left part....	—	— ..	5/VI 31	- 4	- 16
- 5.	— The posterior part of the tail with its longitudinal and transversal musculature	—	— ..	5/VI 31	- 4	- 4
- 6.	— In its house	—	Vejenbrød, Hillerød	2/VI 31	- 2	- 16
- 7.	— The Cercaria without tail	—	—	2/VI 31	- 4	- 4
- 8.	— The Cercaria stretched out of its house.............	—	—	2/VI 31	- 4	- 16
- 9.	— The Cercaria has left its house	—	—	2/VI 31	- 4	- 16
- 10.	— The Cercaria partly extended	—	—	2/VI 31	- 4	- 16
- 11.	— Part of the tail with longitudinal and transversal musculature	—	—	2/VI 31	- 4	- 4
- 12.	— The stylet	—	—	2/VI 31	- 6	- 4

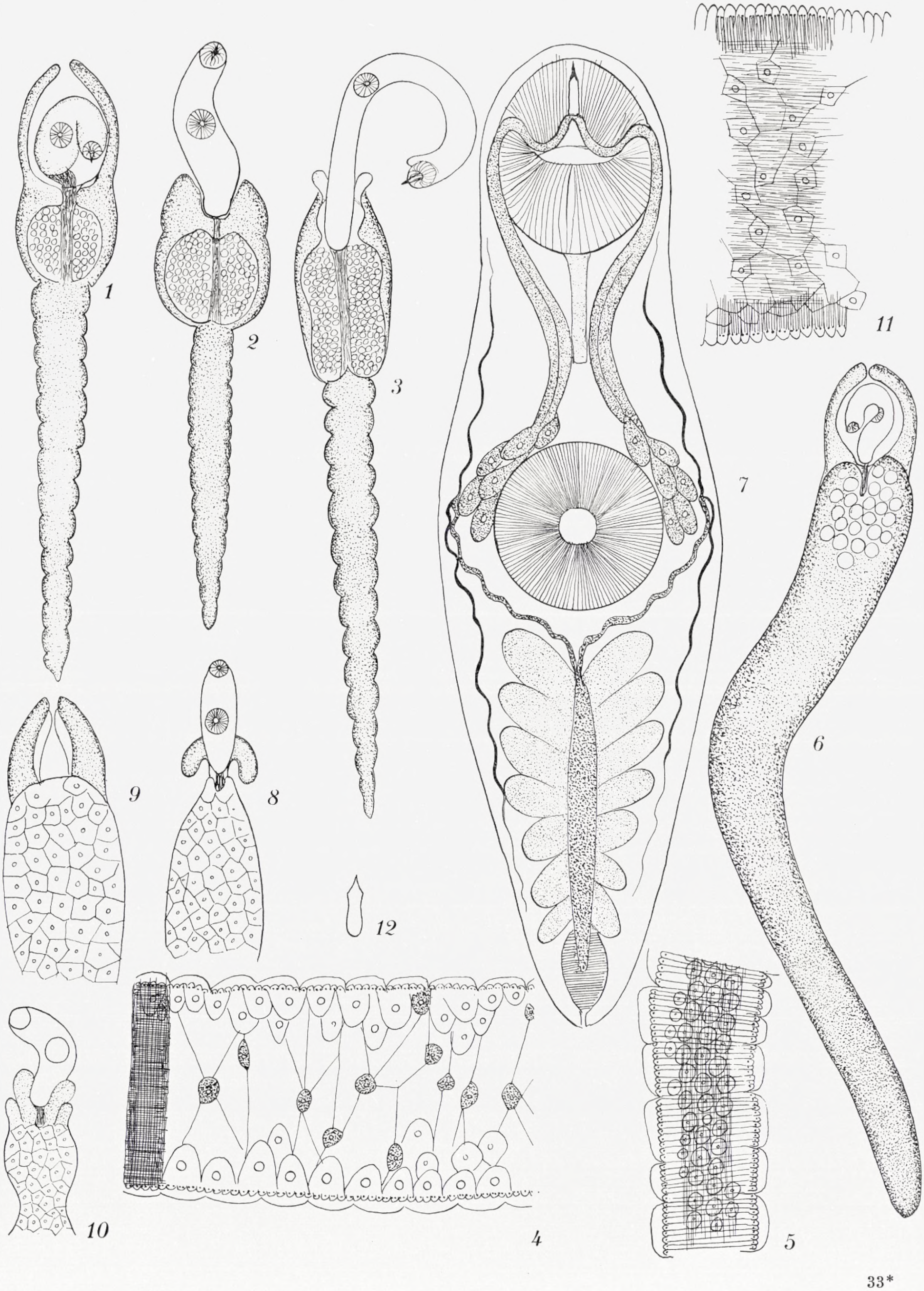
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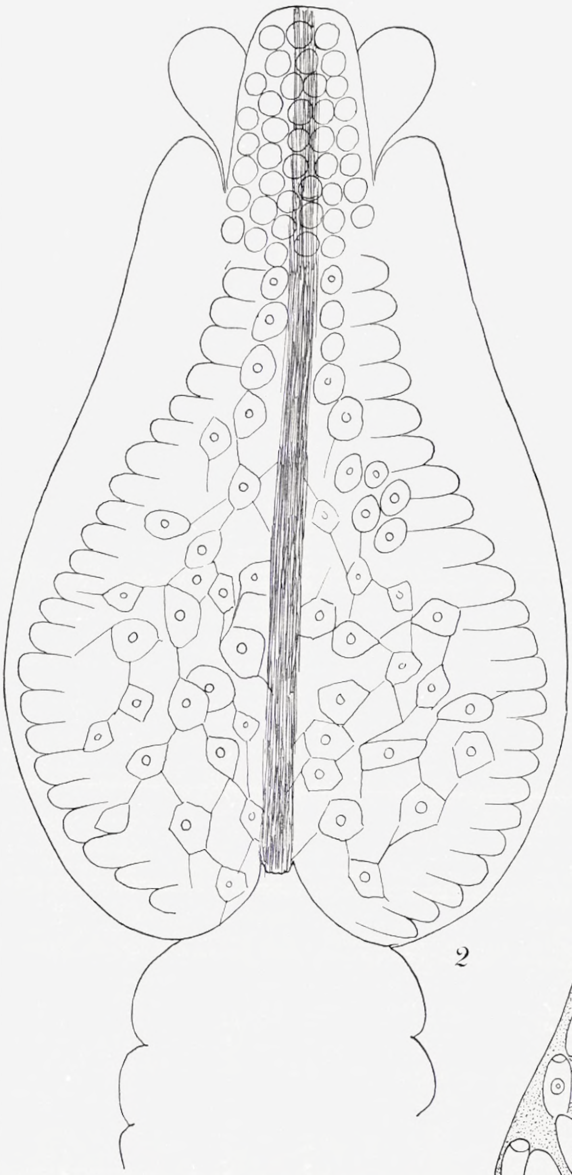
Plate XVIII.

Macrocercaria.

Fig. 1.	*Cercaria vitellilobae* Ssin.	*Sphaerium corneum*	Strødam, Hillerød	5/VI 31	Oc 4	Obj. 4
- 2.	— The anterior part of the tail with the muscle in the middle line	—	—	5/VI 32	- 4	- 4
- 3.	*Cercaria Pagenstecheri.* A Sphaerium with the vibrating Cercariae round the borders of the shell	—	—	2/VI 31		
- 4.	*Cercaria vitellilobae.* Sporocyst	—	—	5/VI 31	- 2	- 16
- 5.	— A very old Sporocyst	—	—	17/III 31	- 6	- 16

Plate XVIII



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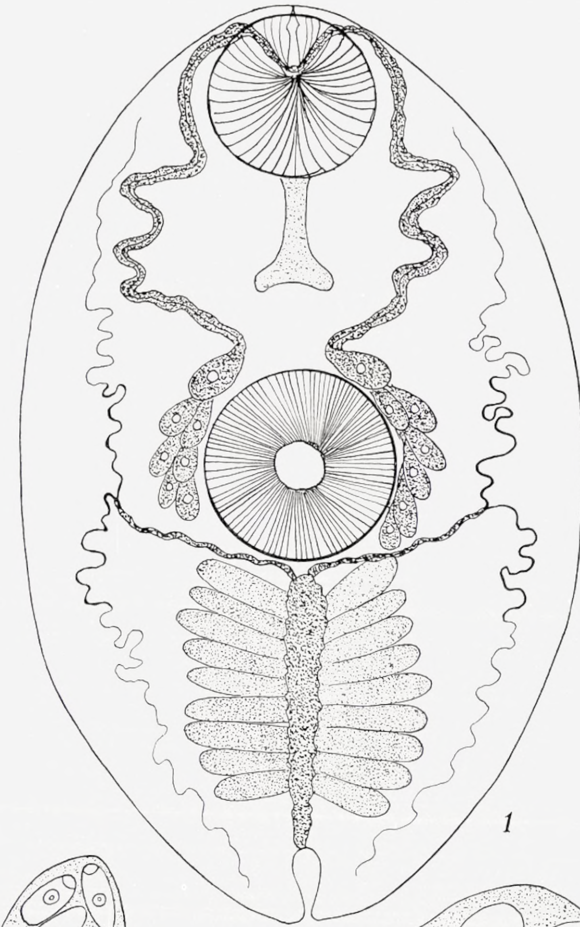

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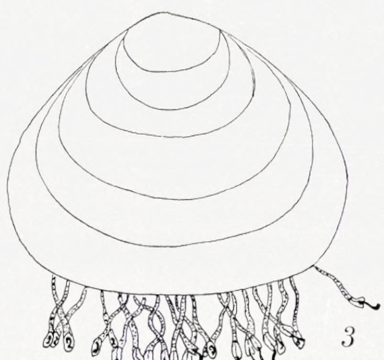

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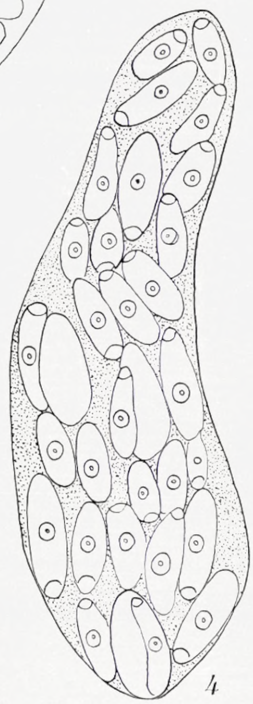

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Plate XIX.

Cystocercaria.

Fig. 1.	*Cercaria splendens*	Taken in Plancton, Fureso	/VII 10	Oc. 4	Obj. 16
- 2.	—	— —	/VII 10	- 4	- 16
- 3.	—	— —	/VII 10	- 4	- 16
- 4.	*Cercaria C. Szidat*.....................	Tuelsø, Sorø	/IX 33	- 6	- 16
- 5.	— from the lens of *Gobio fluviatilis*	—			
- 6.	— The young Diplostomum	—		- 6	- 16
- 7.	— The fully developed Diplostomum	—		- 6	- 16
- 8.	— The young Cercaria which has just entered the lens. Almost the same stage as fig. 6	—		- 2	- 4
- 9.	— The same specimen as fig. 5; the larva has withdrawn from the cuticula; larval organs are not observed and the oral sucker of the Diplostomum is to be formed	—		- 2	- 4
- 10.	A Diplostomum found in the lens of *Abramis blicca*.....................	The Castle Lake, Hillerød	10/III 32	- 2	- 4

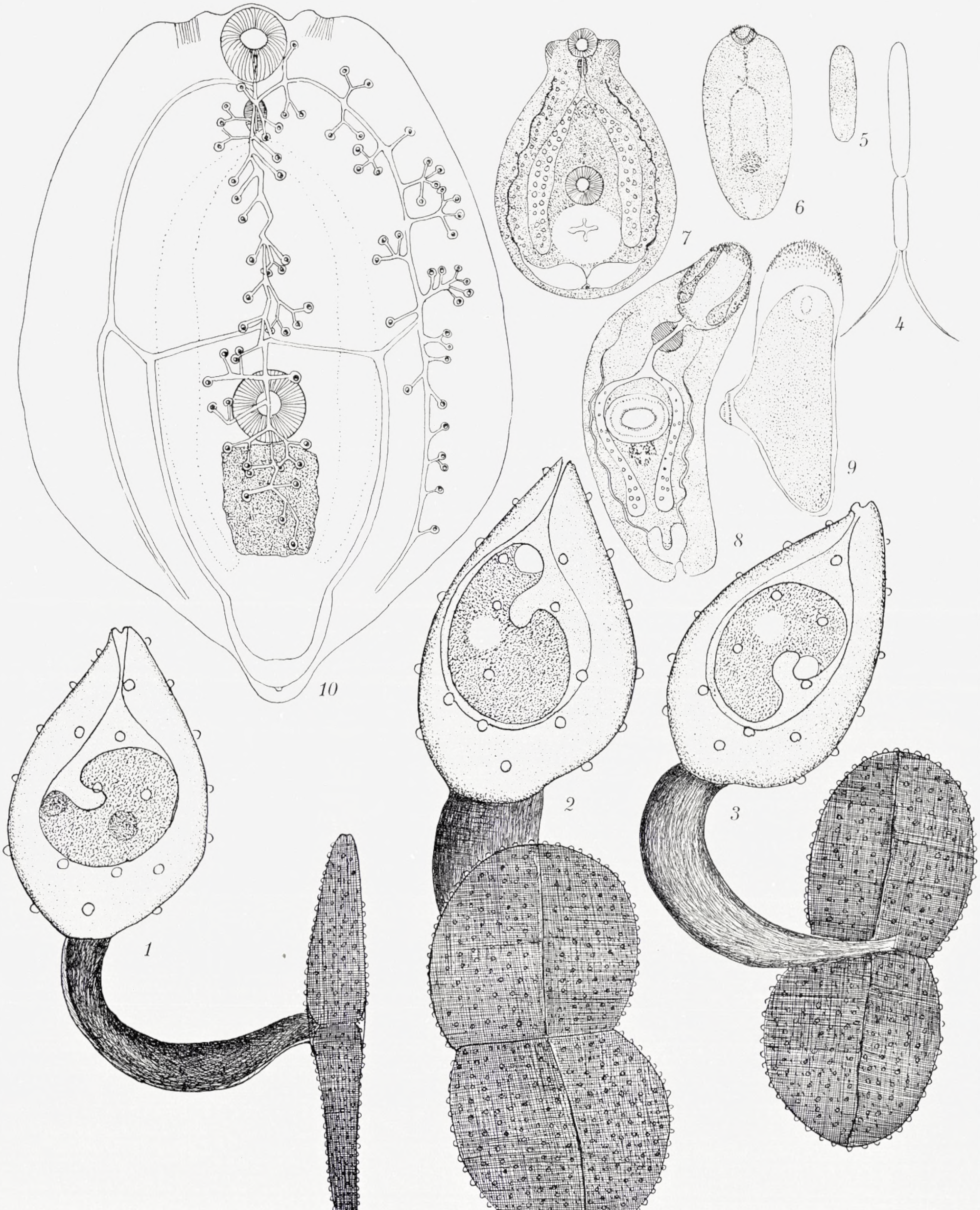
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Plate XX.

Furcocercaria.

Fig. 1.	*Cercaria cristata.* The musculature of the tail only drawn in the upper part of the tail	*Limnaea stagnalis*	28/V 32	Oc. 6	Obj. 4
- 2—5.	The body of the same specimen drawn in the course of two minutes	—	28/V 32	- 4	- 4
- 6.	The mother sporocyst, very old, containing daughter sporocysts; some of them force their way through the skin.....................................	—	28/V 32	- 4	- a*
- 7.	Another Sporocyst containing daughter sporocysts; one large, packed with germs, many small and a few ripe Cercariae which are fully hatched.......	—	28/V 32	- 6	- 16
- 8.	The tip of the mother sporocyst	—	28/V 32	- 8	- 4
- 9.	A sporocyst bursting, liberating its enormous amount of Cercaria germs	—	28/V 32	- 6	- a*
- 10.	The posterior end of a mother sporocyst with its sucker	—	28/V 32	- 6	- 16

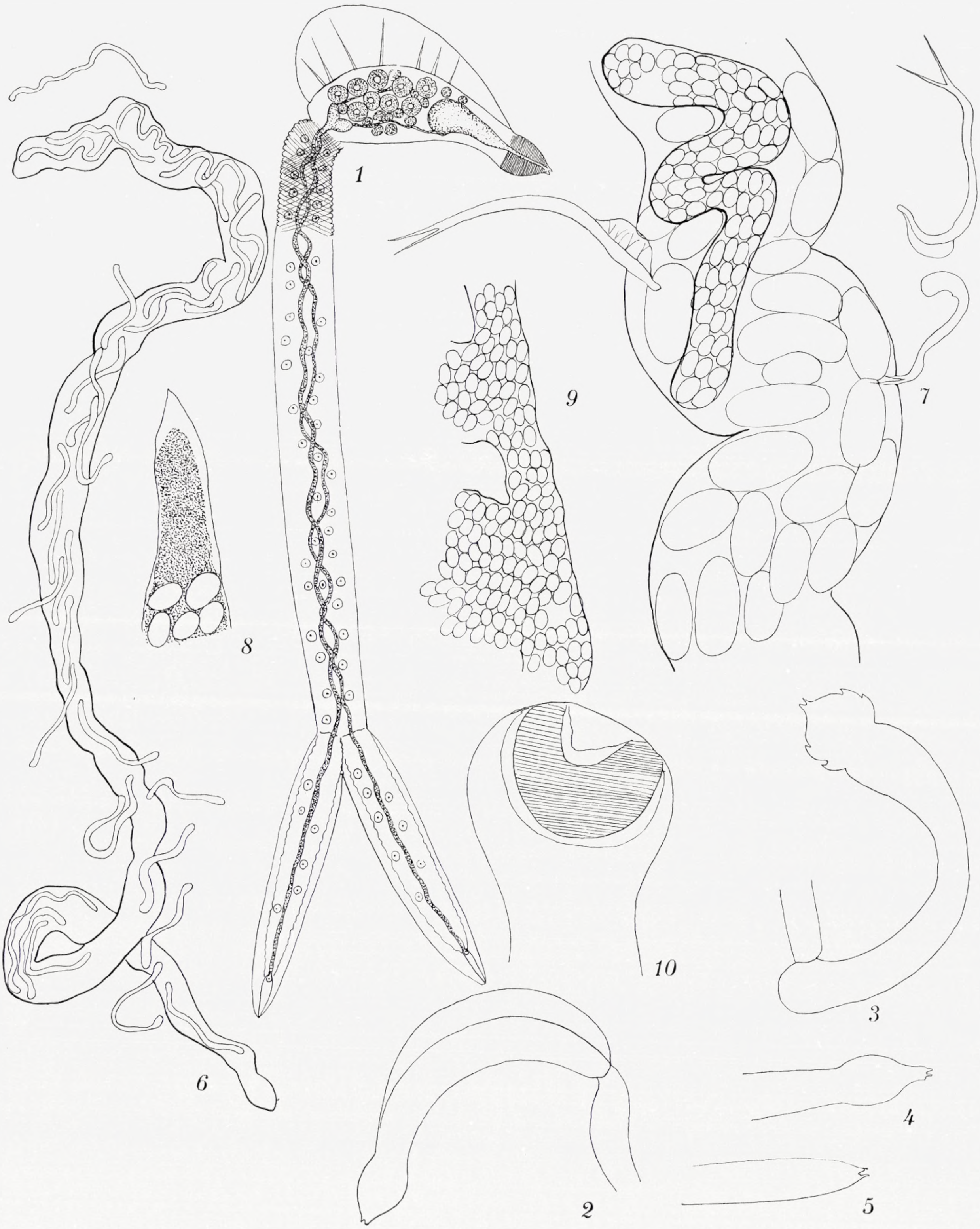
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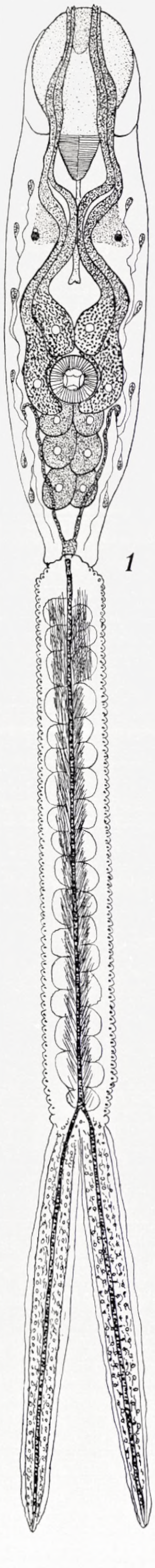
Plate XXI.

Furcocercaria.

Fig. 1.	*Cercaria ocellata*	*Limnaea stagnalis*	Hørsholm	2/VII 32	Oc. 4	Obj. 4
- 2.	— The body seen laterally, slightly compressed	—	—	2/VII 32	- 4	- 4
- 3.	— The body in the piercing position giving off secreta from the penetration glands	—	—	2/VII 32	- 4	- 4
- 4.	— The body fully extended	—	—	2/VII 32	- 4	- 4
- 5.	*Cercaria Bilharziellae polonicae*	*Planorbis corneus*	—	5/VII 31	- 4	- 4
- 6.	— The body, lateral view	—	—	5/VII 31	- 4	- 4
- 7.	— Sporocysts	—	—	5/VII 31	- 4	- 16



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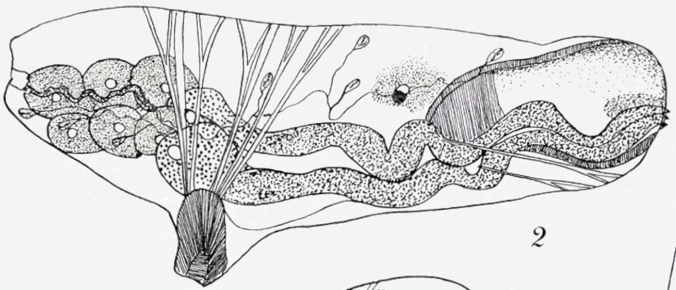

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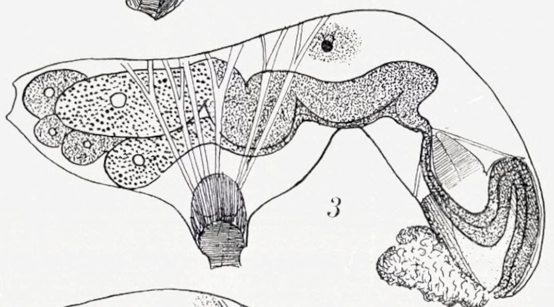

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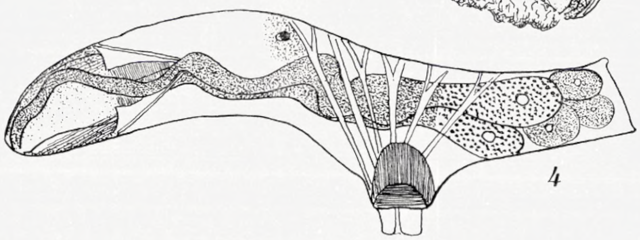

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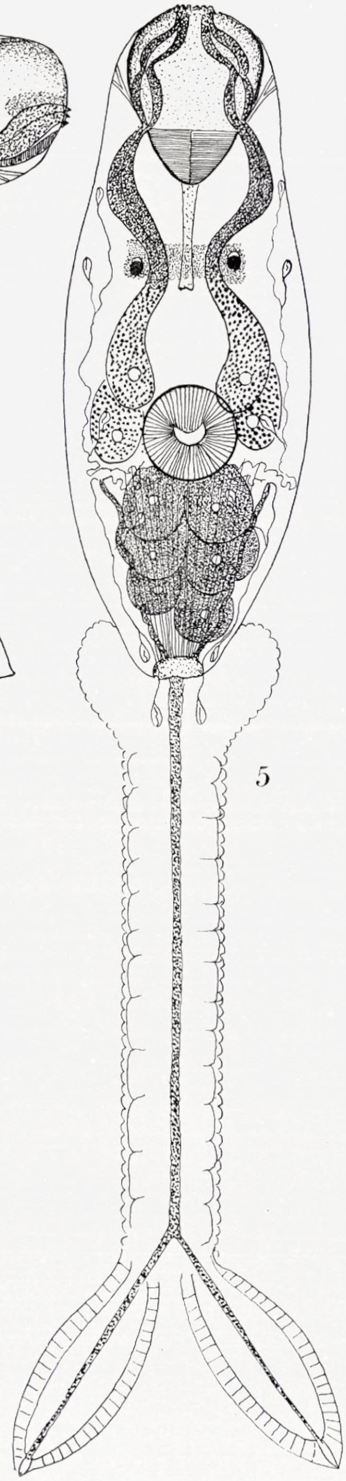

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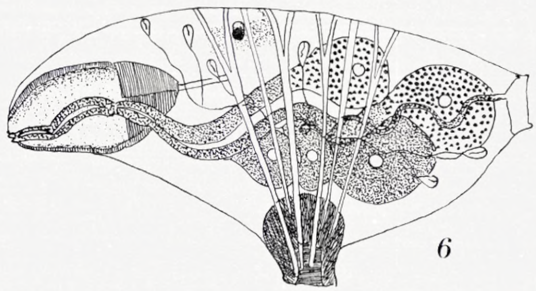

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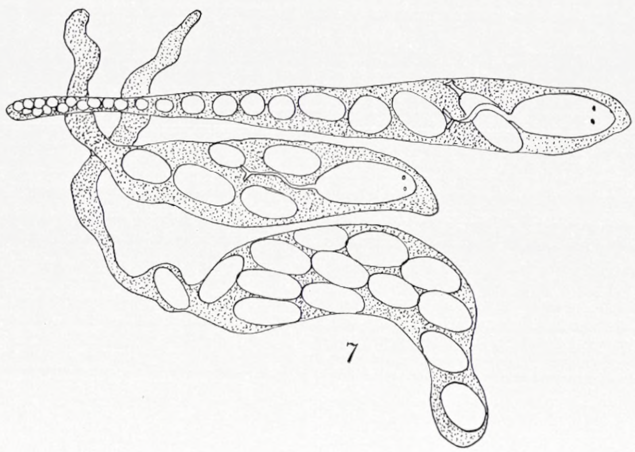

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Plate XXII.

Furcocercaria.

Fig. 1.	*Furcocercaria longiremis*	*Valvata piscinalis*	Tjustrup Lake	25/VII 31	Oc. 4	Obj. 4
- 2.	— Sporocyst	—	—	25/VII 31	- 4	- 16
- 3.	*Valvata* throwing out the Cercariae from the branches of the gill		—	25/VII 31	- 2	- a*
- 4.	*Furcocercaria C. Szidat.* Mother sporocyst	*Limnaea stagnalis*	Bagsværd Lake	2/VII 31	- 2	- a*
- 5.	— The tip of the mother sporocyst throwing out the daughter sporocysts; the tip is very mobile	—	—			
- 6.	*Furcocercaria strigeae tardae.* The mother sporocyst	—	Strødam	1/VII 31	- 6	- a*
- 7.	*Furcocercaria Frederiksborgensis* n. sp.	*Planorbis corneus*	Torkeris Pond	26/IV 32	- 4	- 4
- 8.	— Sporocyst	—	—	26/IV 32	- 4	- 4

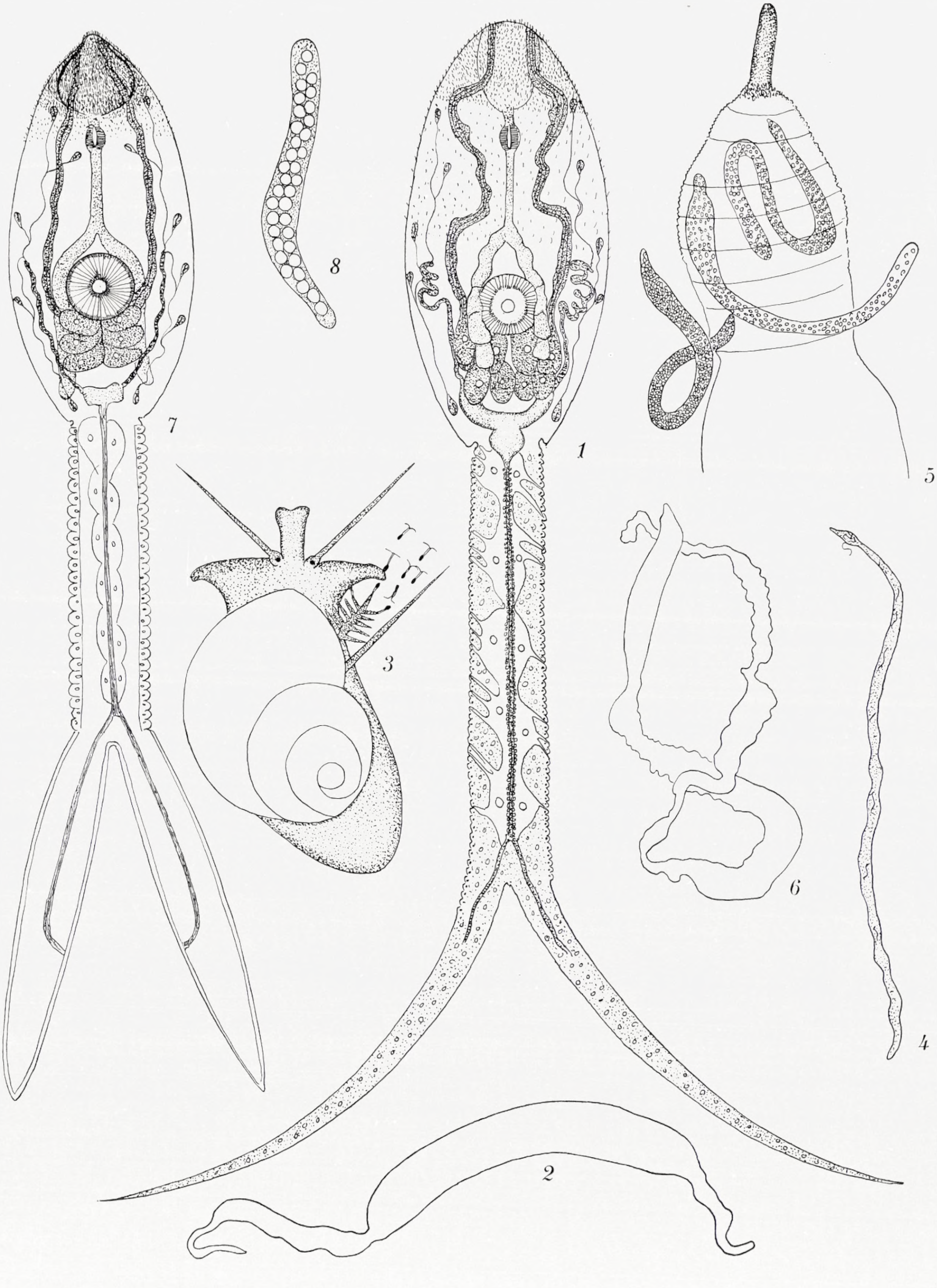
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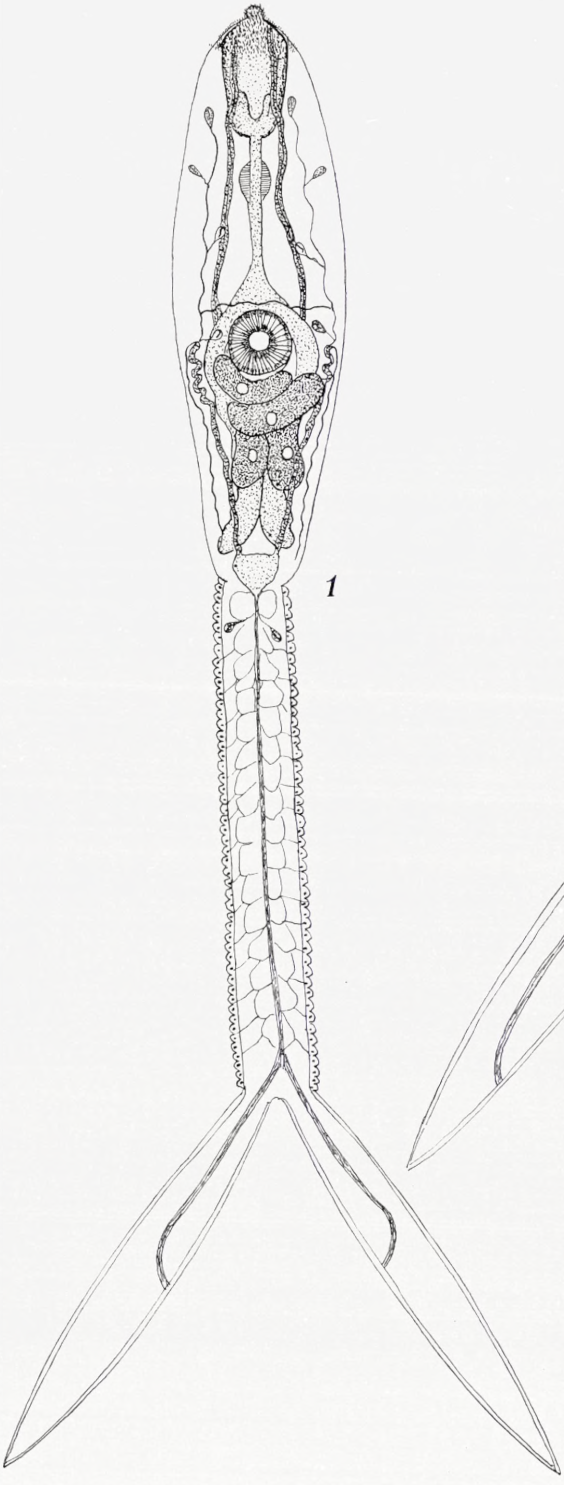
Plate XXIII.

Furcocercaria.

Fig. 1.	*Furcocercaria C. Szidat*	*Limnaea stagnalis*.....	Bagsværd Lake	2/VII 32	Oc. 4	Obj. 4
- 2.	*Furcocercaria* F_1 Harper	*Planorbis umbilicatus*..	Furesø	2/V 32	- 4	- 4
- 3.	*Furcocercaria strigeae tardae*...	*Limnaea stagnalis*.....	Strødam Pond	11/VII 31	- 4	- 4

Plate XXIII



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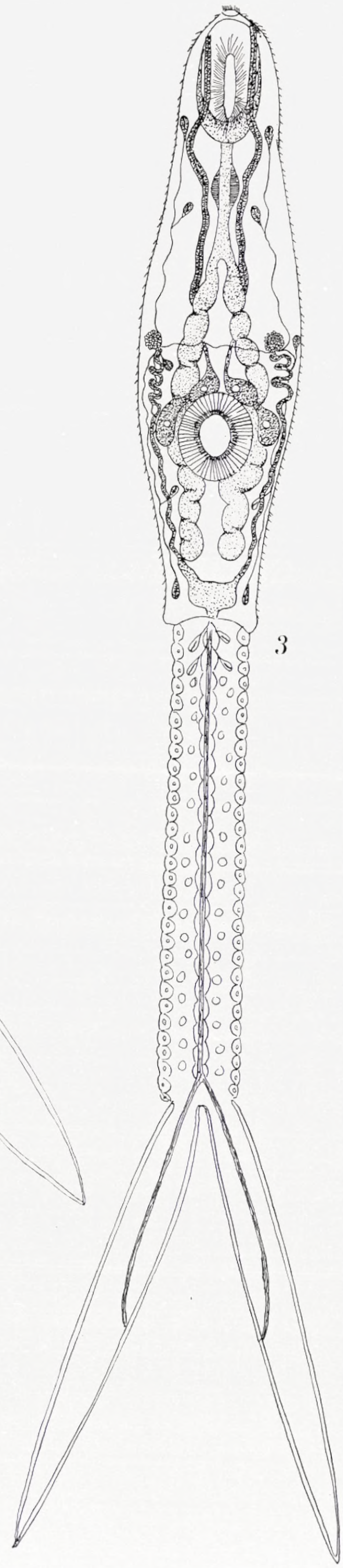

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Plate XXIV.

Cercaria A Szidat Cotylurus cornutus.

Fig. 1. The Tetracotyle stage from *Limnaea stagnalis*. Strødam 15/IX 33. .... Oc. 6 Obj. 16

Fig. 2. A Tetracotyle found in *Limnaea palustris*. Furesø 3/V 32. The gelatinous cover is not drawn... Oc. 6 Obj. 16

Figs. 3—8. Sections of Tetracotyle *Cotylurus cornutus*. *Cercaria A. Szidat.*

Figs. 3—5 horizontal sections, figs. 6—7 transversal sections, fig. 8 sagittal section.

Figs. 3—7 through the resting Tetracotyle stage; fig. 8 through the creeping stage near the metamorphosis into the resting stage. Thionine-Acid Fuchsine Aurantia . Oc. 4 Obj. 4

Abbreviations on Pl. XXIV and XXV.

O.S. = Oral sucker.
V.S. = Ventral sucker.
H.G. = Holdfast grooves.
H.O. = Holdfast organ.
Ph. = Pharynx.
I.C. = Intestinal coeca.
Ex.p. = Excretory pore.
Ex. = Excretory organ.
G.O. = Genital organ.


H.G.
O.S.
V.S.
Ex.
H.O.
G.O.
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Plate XXV.

The metamorphosis of Cercaria A. Szidat. Cotylurus cornutus.

Figs. 1—10 drawn with the same power (Oc. 4 Obj. 16).

- 1 The Cercaria.
- 2 The earliest found specimen shortly after it has entered the snail.
- 3—6 shows the enormous growth, during which all larval organs disappear. The flat organism has free power of motion; it is a creeping organism.
- 7 The parasite is almost quite transformed into the Tetracotyle; it has a slight power of motion. The size has diminished; the body is much darker; the organs characteristic of the Tetracotyle stage are in preparation.
- 8 The stage in which motion has ceased.
- 9—10 The figures show how the size diminishes; Fig. 10 is the typical Tetracotyle without the gelatinous layers.
- 11—12 Two longitudinal sections through the creeping stage. Fig. 11 shows a specimen younger than fig. 12. The two figures show that the holdfast organ begins as protuberances which later on are invaginated. Oc. 4 Obj. 4. Haematoxyline, Azure Eosin.
- 13 A transversal section of the same stage. Oc. 4 Obj. 4, Haematoxyline, Azure Eosin.
- 14 A creeping larva found in a Sporocyst of a xiphidioid Trematode in *Limnaea stagnalis* (Hillerød 22/IV 31). The figure shows the enormous size of the larva in comparison with the host; it is further seen that the germ balls are intact and the larva must be nourished endosmotically.
- 15—16 Two different Tetracotyle from the same snail, to show the great difference in size. Oc. 4 Ob. 16.


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V.S.
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Plate XXVI.

Furcocercaria.

Fig. 1.	*Furcocercaria linearis* n. sp.	*Planorbis corneus*	Hørsholm	25/V 32	Oc. 4	Obj. 4
- 2.	— contracted	—	—	25/V 32	- 4	- 4
- 3.	*Furcocercaria helvetica XXXI* Dubois	*Limnaea palustris*	Indelukket, Hillerød	13/IX 32	- 4	- 4
- 4.	— contracted	—	—	13/IX 32	- 4	- 4
- 5.	— The mother Sporocyst empty, only containing one single daughter Sporocyst	—	—	13/IX 32	- 2	- 16
- 6.	— A daughter Sporocyst packed with germs . .	—	—	13/IX 32	- 4	- 16
- 7.	— Part of the mother Sporocyst to show the very thick walls and the cell network	—	—	13/IX 32	- 4	- 4

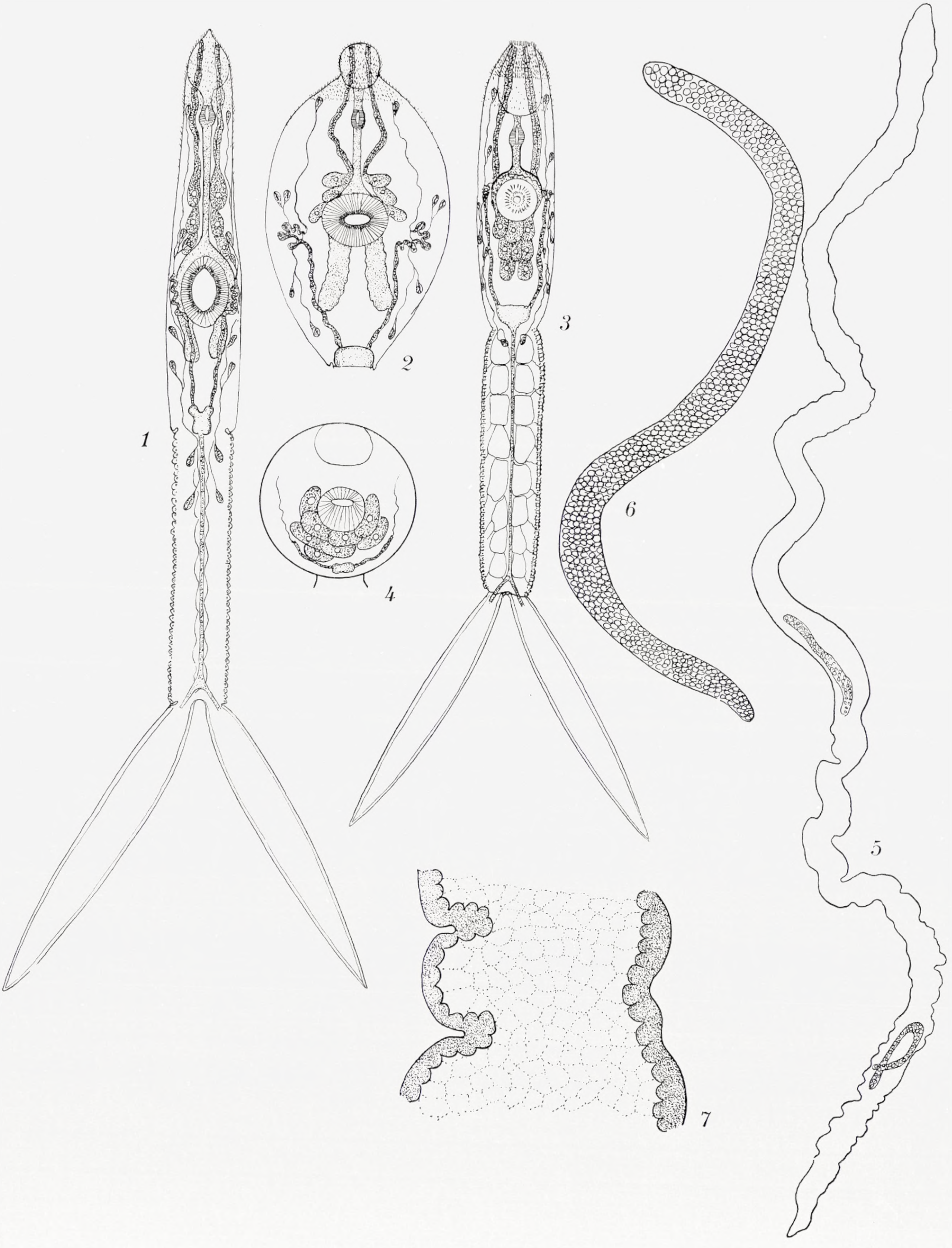
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Plate XXVII.

Fig. 1.	*Furcocercaria A. Szidat*	*Limnaea palustris* . .	Furesø	25/V 32	Oc. 4	Obj. 4
- 2.	*Furcocercaria letifera*	*Limnaea auricularia*	Susaa, Sorø	2/VI 31	- 4	- 4
- 3.	— mother Sporocyst	—	—	2/VI 31	- 4	- a*
- 4.	— Sporocyst	—	—	2/VI 31	- 4	- 16
- 5—8.	— Sporocysts . . . . The figures illustrate the extremely variable forms.	—	—	2/VI 31	- 4	- 16

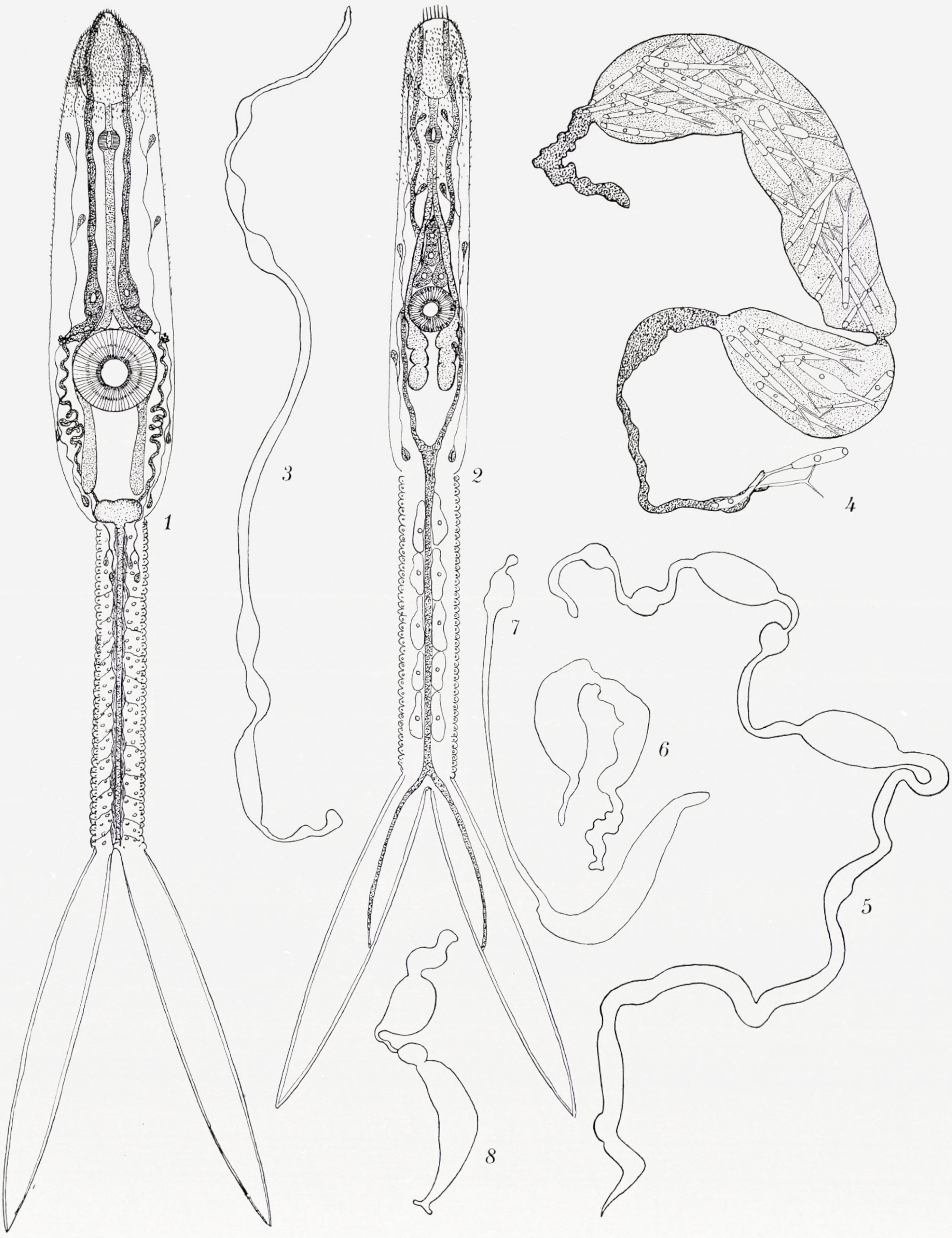
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Plate XXVIII.

Furcocercaria.

Fig. 1.	*Furcocercaria I Petersen*	*Limnaea ovata*	Hørsholm	12/VIII 32	Oc. 4	Obj. 4
- 2.	—	*Physa fontinalis*	Tjustrup Lake	12/VIII 31	- 4	- 4
- 3.	— contracted	—		12/VIII 31	- 6	- 4
- 4.	*Furcocercaria vivax.* Posterior end of the Sporocyst	*Bithynia tentaculata*	Hellebæk	25/V 32	- 2	- 4
- 5.	— The Cercaria seen laterally. The dorsal attachment of the tail and the six openings for the penetration glands are seen	—	—	25/V 32	- 4	- 4
- 6.	— Sporocyst	—		25/V 32	- 4	- 16
- 7.	*Furcocercaria ocellata.* The figures illustrate the different positions of the Cercariae when attached to the substratum	*Limnaea stagnalis*	Hørsholm	5/VIII 32		
- 8.	— Sporocysts	—	—	5/VIII 32	- 4	- 16
- 9.	— Sporocyst	—	—	5/VIII 32	- 4	- 16

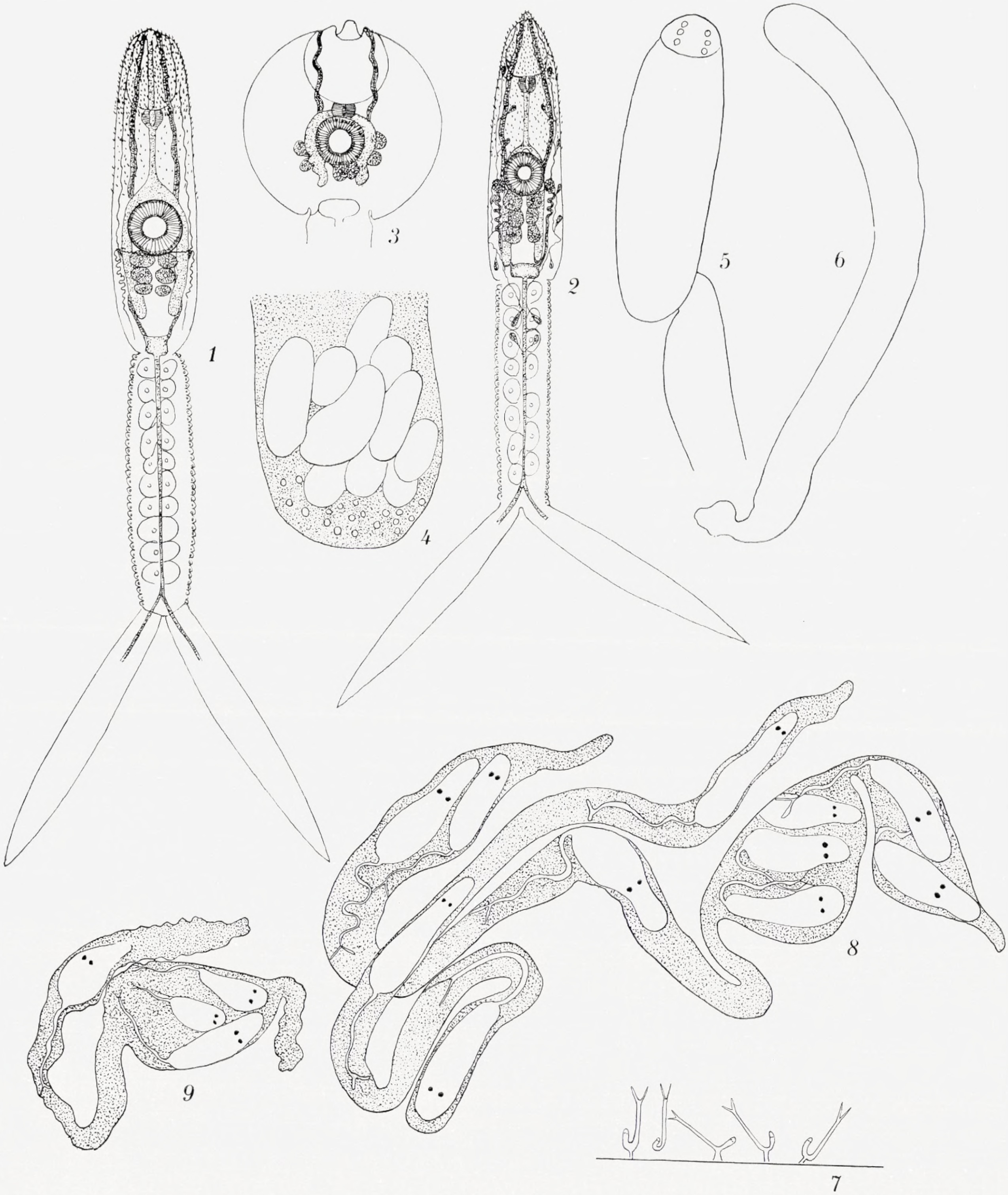
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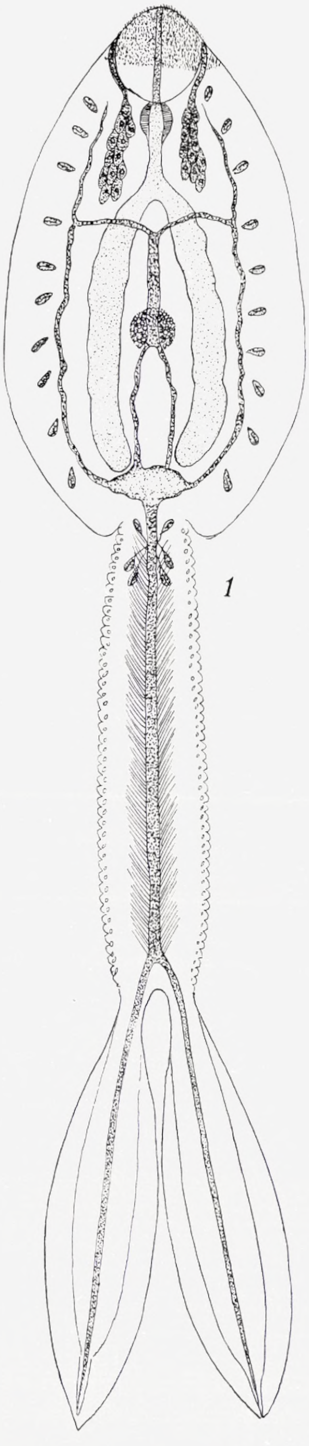
Plate XXIX.

Furcocercaria.

Oc. 4 Obj. 4.

Fig. 1.	*Furcocercaria vivax*	*Bithynia tentaculata*	Værebro	7/VII 31
- 2.	*Furcocercaria No. 4 Petersen*	—	Furesø	19/IX 31
- 3.	*Furcocercaria* sp.	—	Hellebæk	15/V 32



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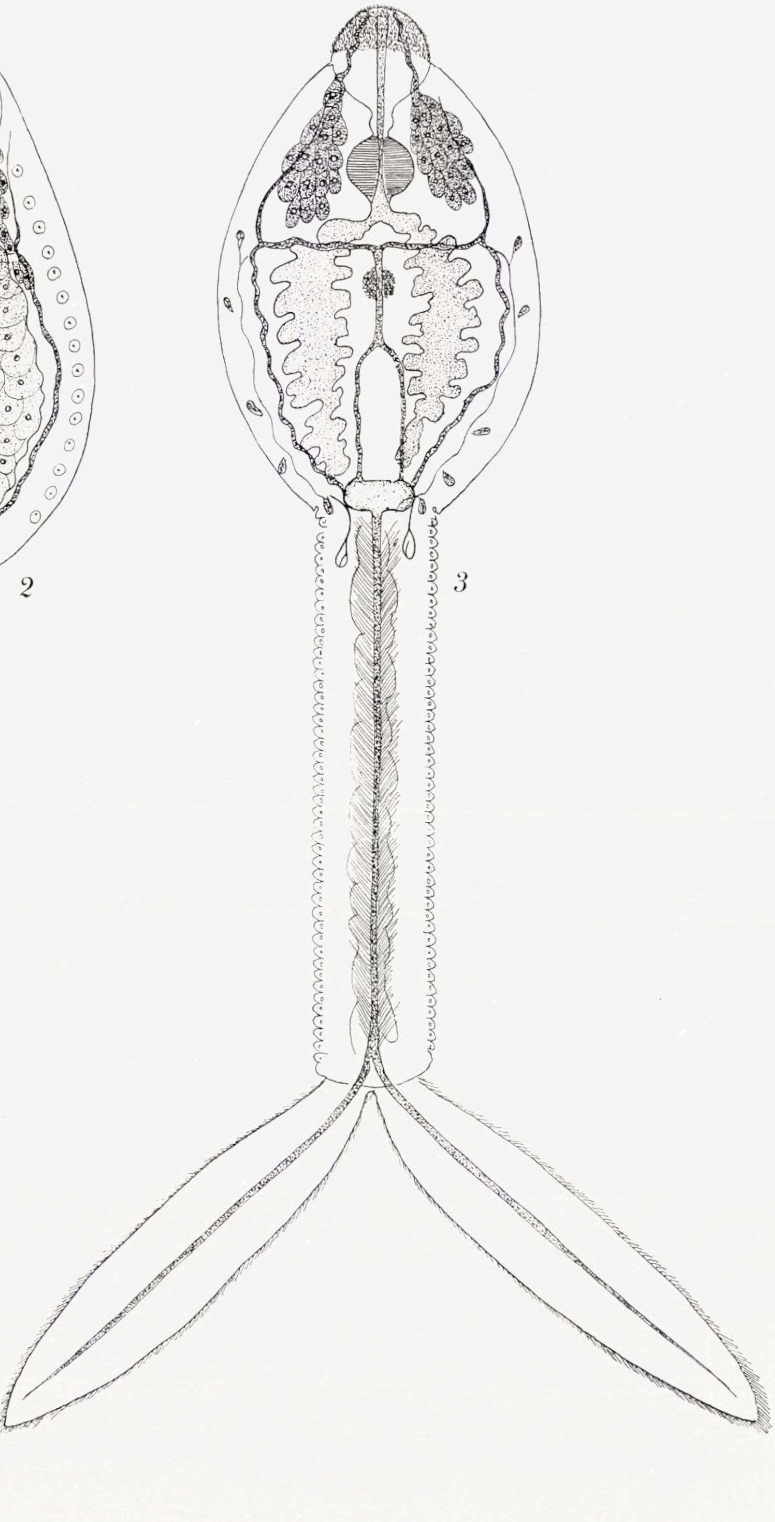

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Plate XXX.

Furcocercaria.

Fig. 1. *Bucephalus polymorphus* on the bottom .... *Anodonta* Hørsholm /V 33

- 2. } — different resting positions .... —
- 3. }

- 4—8. — suspended in the water layers; in fig. 4 the larva stands deepest, in figs. 5 and 6 the rami of the furca are extended; in fig. 7 the rami are bent outwards; during the extension of the arms the animal is lifted upwards; using the cross section resistance, the animal stands for a moment in the new water layer; when they are again drawn in (fig. 8), the animal slowly sinks downwards again. The drawings are half camera half free-hand-drawings.

- 9. — Sporocyst .... Oc. 5 Obj. 16

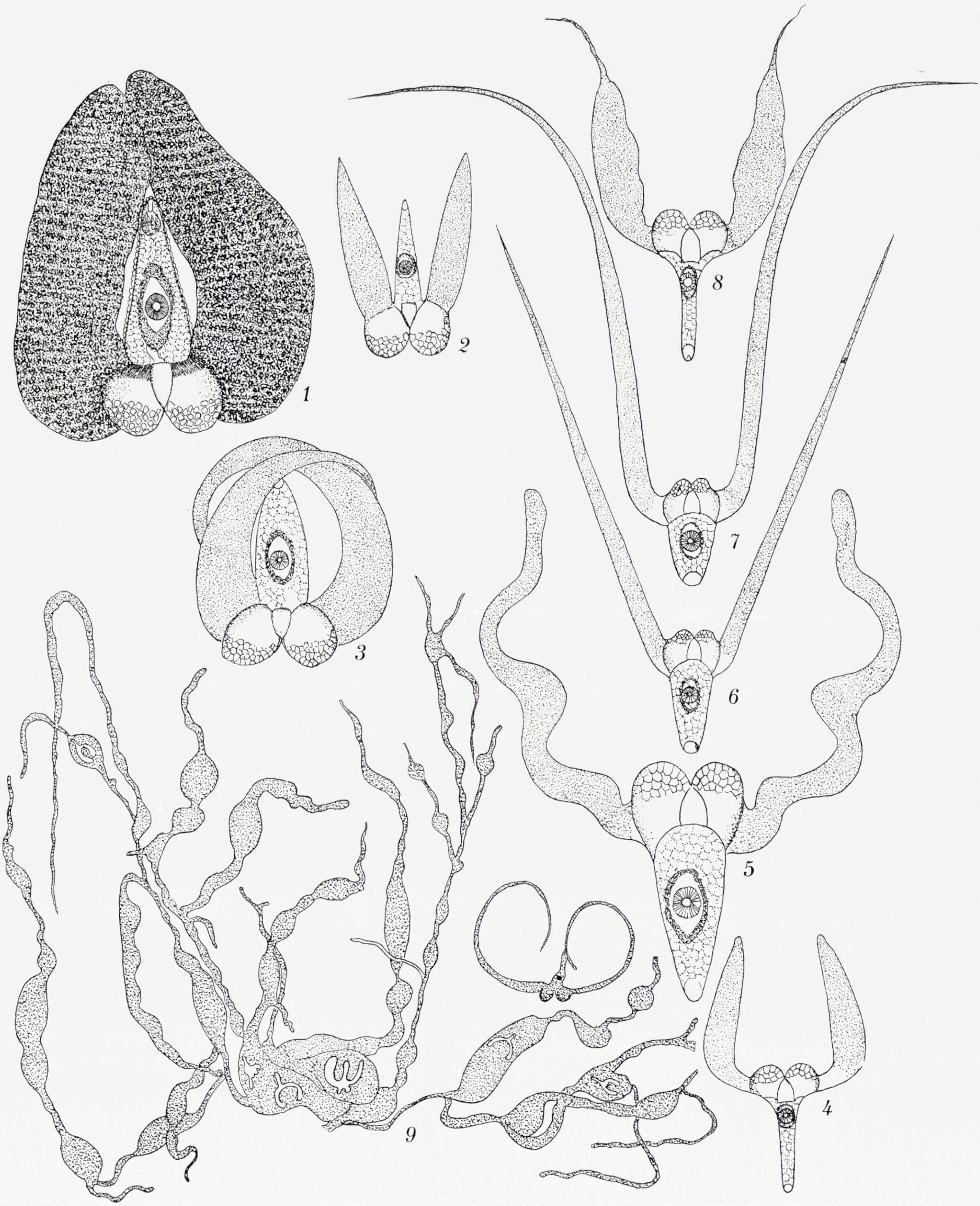
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Plate XXXI.

Microcercaria.

Fig. 1.	*Cercaria micrura*	*Bithynia tentaculata*	Furesø	18/IX 31	Oc. 4	Obj. 4
- 2.	— Redia	—	—	18/IX 31	- 4	- 16
- 3.	—	—	Esrom Lake	27/IX 31	- 4	- 4
- 4.	— extended	—	—	27/IX 31	- 4	- 4
- 5. } - 6. }	— Rediae packed with Microcercariae and a few Cercariaea	—	—	27/IX 31	- 2	- 16
- 7.	— The same Redia drawn in the course of 5 minutes	—	—	27/IX 31	- 2	- 16
- 8.	— The lower part of a Redia with a Microcercaria and a Cercariaeum cyst	—	—	27/IX 31	- 2	- 16
- 9.	— A cyst found in the Redia of a *Cercaria micrura*	—	—	27/IX 31	- 4	- 4
- 10.	— A Cercariaeum taken out of a cyst found in the Redia of *Cercaria micrura*	—	—	27/IX 31	- 4	- 4

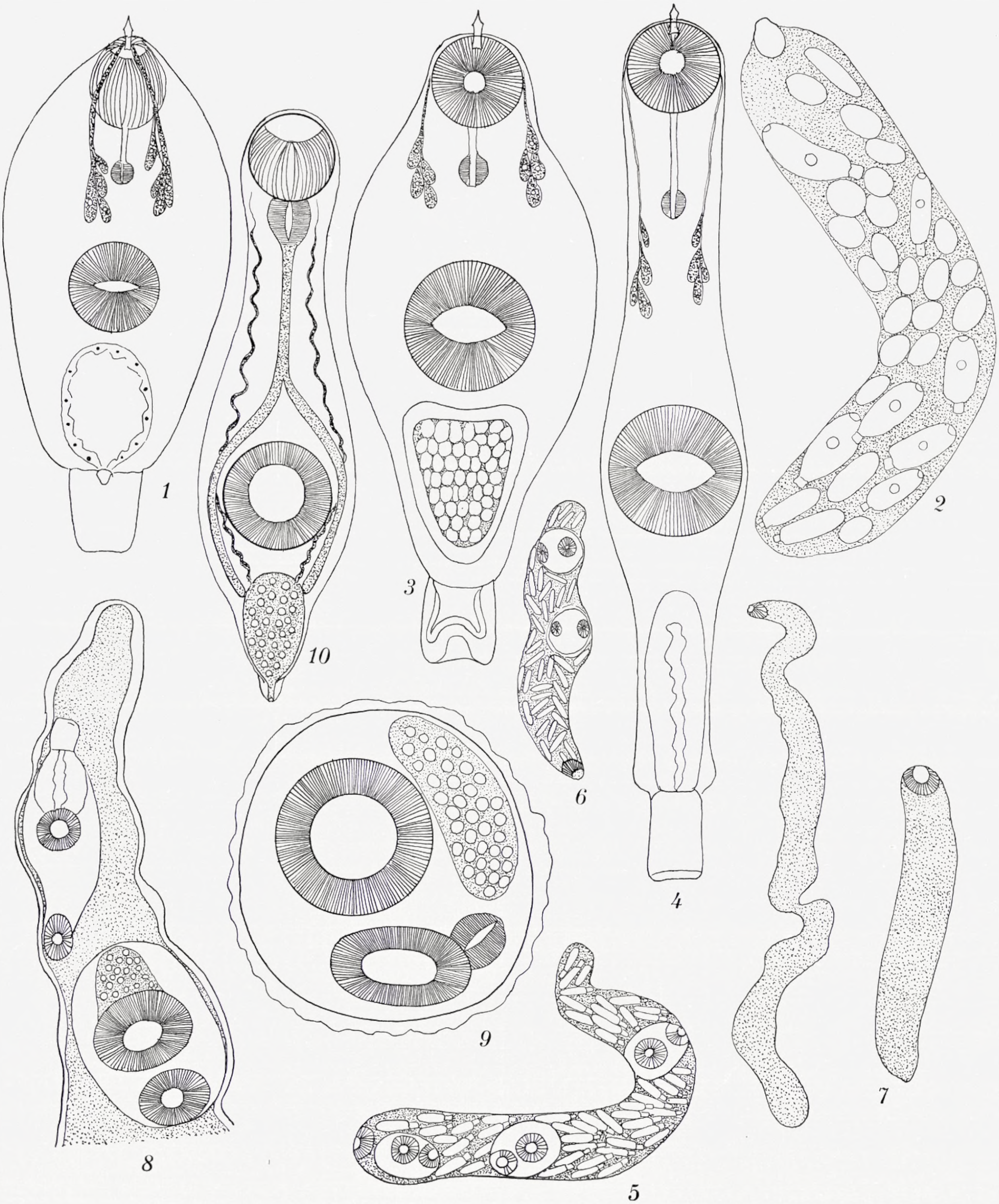
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Plate XXXII.

Fig. 1.	*Cercariaeum paludinae impurae*	*Bithynia tentaculata*	Langesø, Hillerød	21/VI 31	Oc. 2	Obj. 4
- 2.—3.	— The same specimen drawn in the course of 5 minutes.......	—	—	21/VI 31	- 4	- 16
- 4.	— Redia	—	—	21/VI 31	- 2	- 16
- 5.	— Redia	—	—	21/VI 31	- 2	- 16
- 6.	— Cyst	—	—	21/IV 31	- 2	- 16
- 7.	*Leucochloridium paradoxum*	*Succinea putris*.....	Tjustrup........	13/V 33	- 2	- 4
- 8.	— Cyst	—	—	13/V 33	- 2	- 4

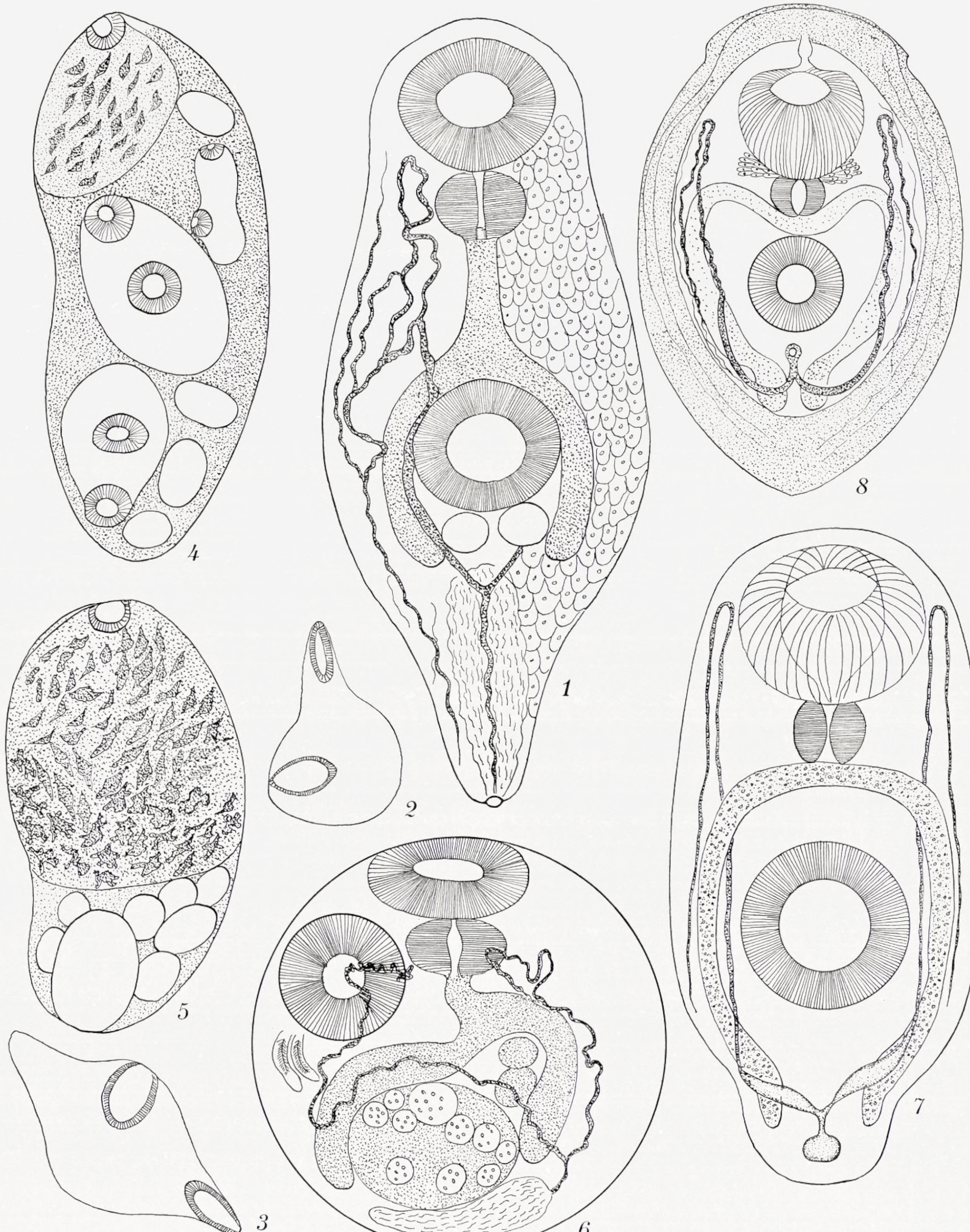
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Plate XXXIII.

Cercariaeum.

Fig. 1.	*Cercariaeum paludinae impurae* . .	*Bithynia tentaculata*	Langesø	17/V 32	Oc. 4 Obj. 16
- 2.	— attached to the antennae of a Bithynia	—	—		
- 3.	*Cercariaeum limnaeae obscurae* . .	*Limnaea ovata*	Torkeris Pond, Hillerød	15/V 31	- 4 - 16
- 4.	*Cercariaeum gibba* n. sp.	*Valvata piscinalis* . .	Furesø	22/IX 31	- 4 - 4
- 5.	— Redia	— . .	—	22/IX 31	- 4 - 4
- 6.	*Cercariaeum crassa* n. sp.	*Pisidium amnicum* .	—	20/IX 31	- 2 - 4
- 7.	*Cercariaeum limnaeae auricularie*	*Limnaea auricularia*	Hulsø	25/VI 32	- 4 - 4

Plate XXXIII

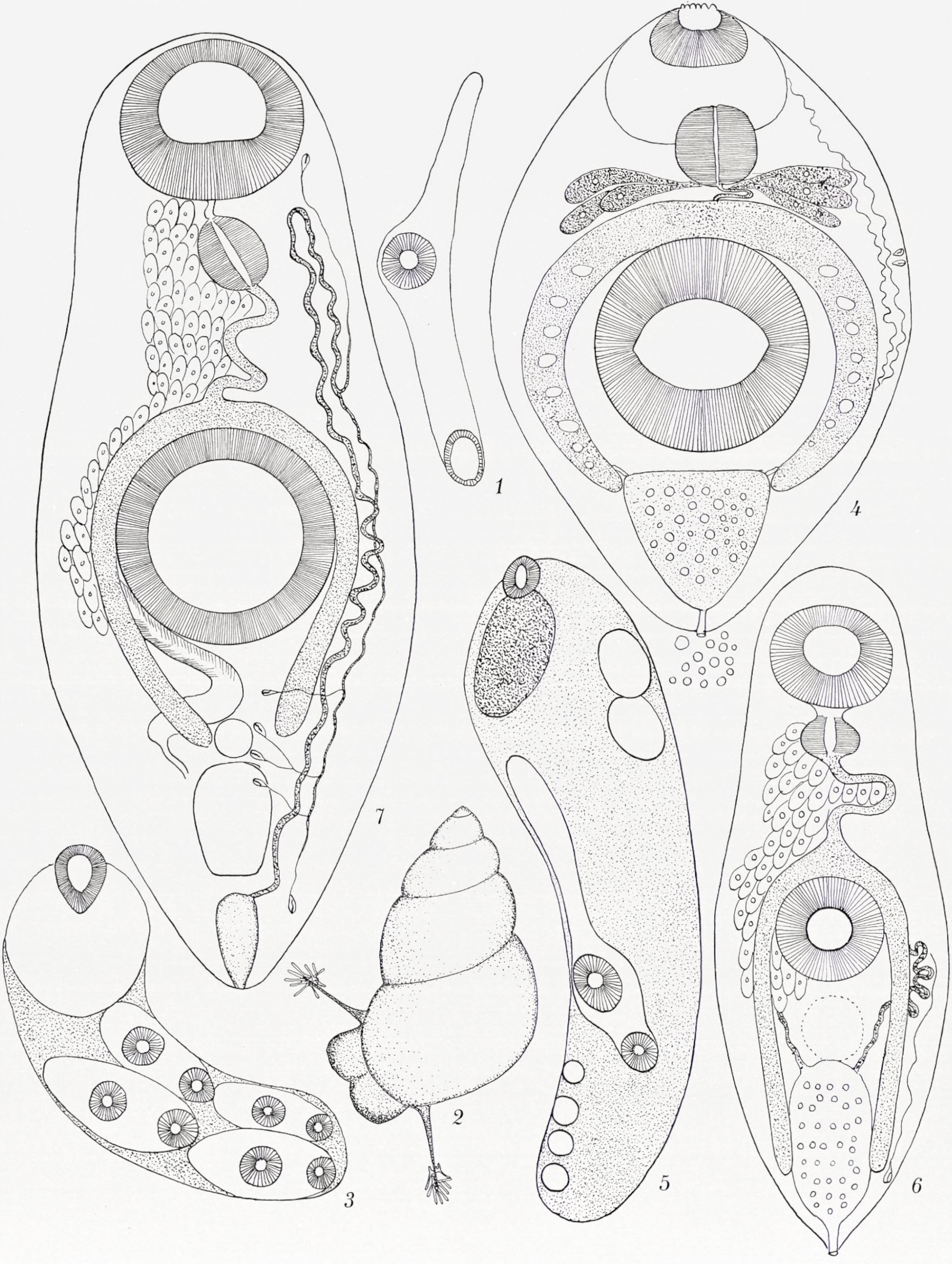

Plate XXXIV.

Cercariaeum.

Fig. 1.	*Cercariaeum limnaeae obscurae*	*Limnaea ovata*	Torkeris Pond, Hillerød	15/V 31	Oc. 4	Obj. 16
- 2.	*Cercariaeum Petersen I*	*Paludina vivipara*	Hellebæk	2/II 32	- 6	- 16
- 3 a—d.	— The same specimen drawn in the course of 5 minutes	—	—	2/II 32	- 4	- 4
- 4.	— group of Spococysts	—	—	2/II 32	- 2	- 4
- 5.	— A single Sporocyst	—	—	2/II 32	- 2	- 4
- 6.	*Cercariaeum gibba* n. sp. taken out of the cyst	*Valvata piscinalis*	Furesø	22/IX 31	- 6	- 16
- 7.	*Cercariaeum limnaeae auriculariae* group of Rediae from the borders of the mantle of the snail	*Limnaea auricularia*	Hulsø	25/VI 32	- 4	- a*
- 8.	*Cercariaeum crassa* n. sp. Redia	*Pisidium amnicum*	Furesø	20/IX 32	- 4	- 16
- 9.	— taken out of the Sporocyst	—	—	20/IX 32	- 4	- 16

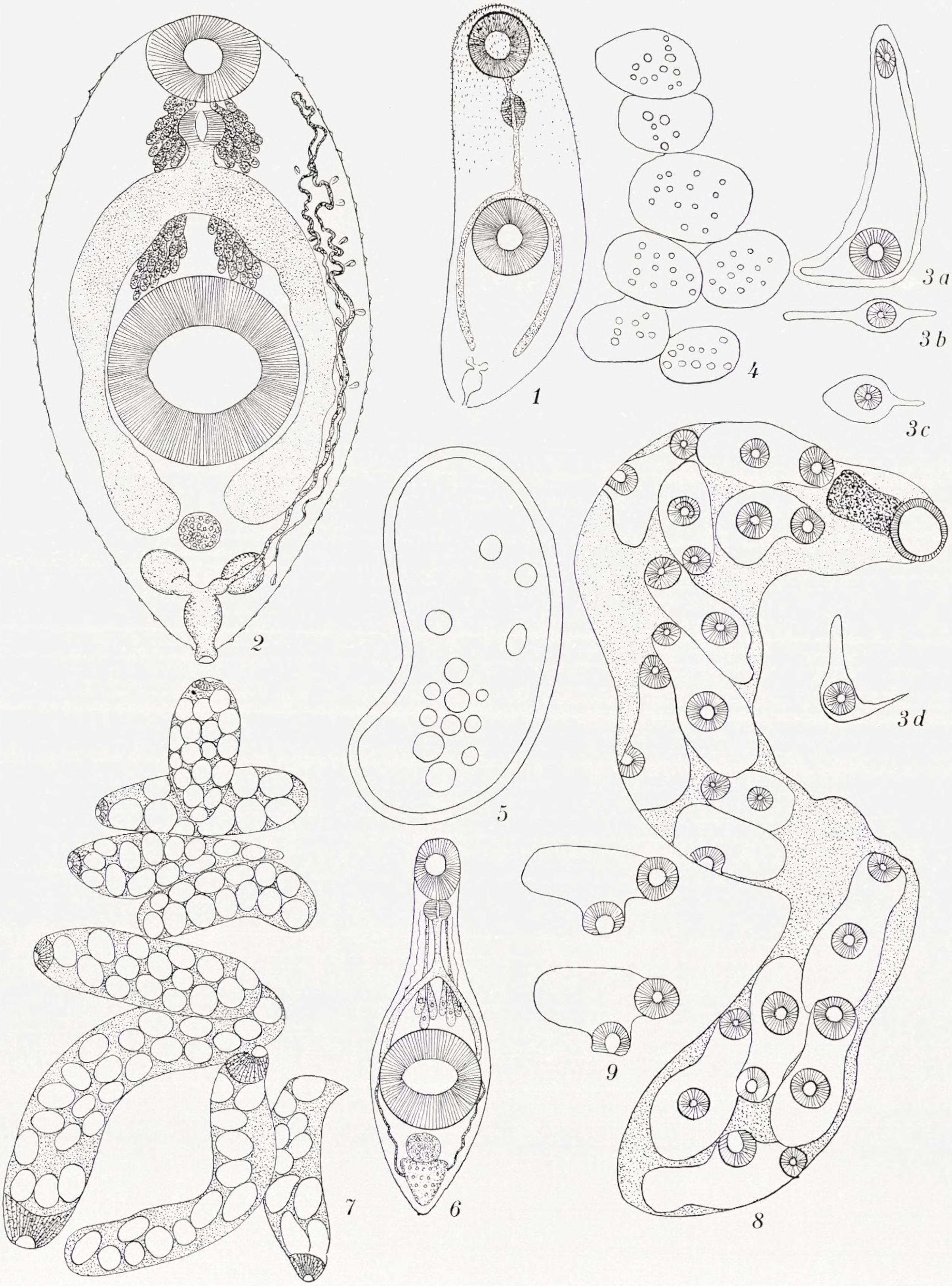
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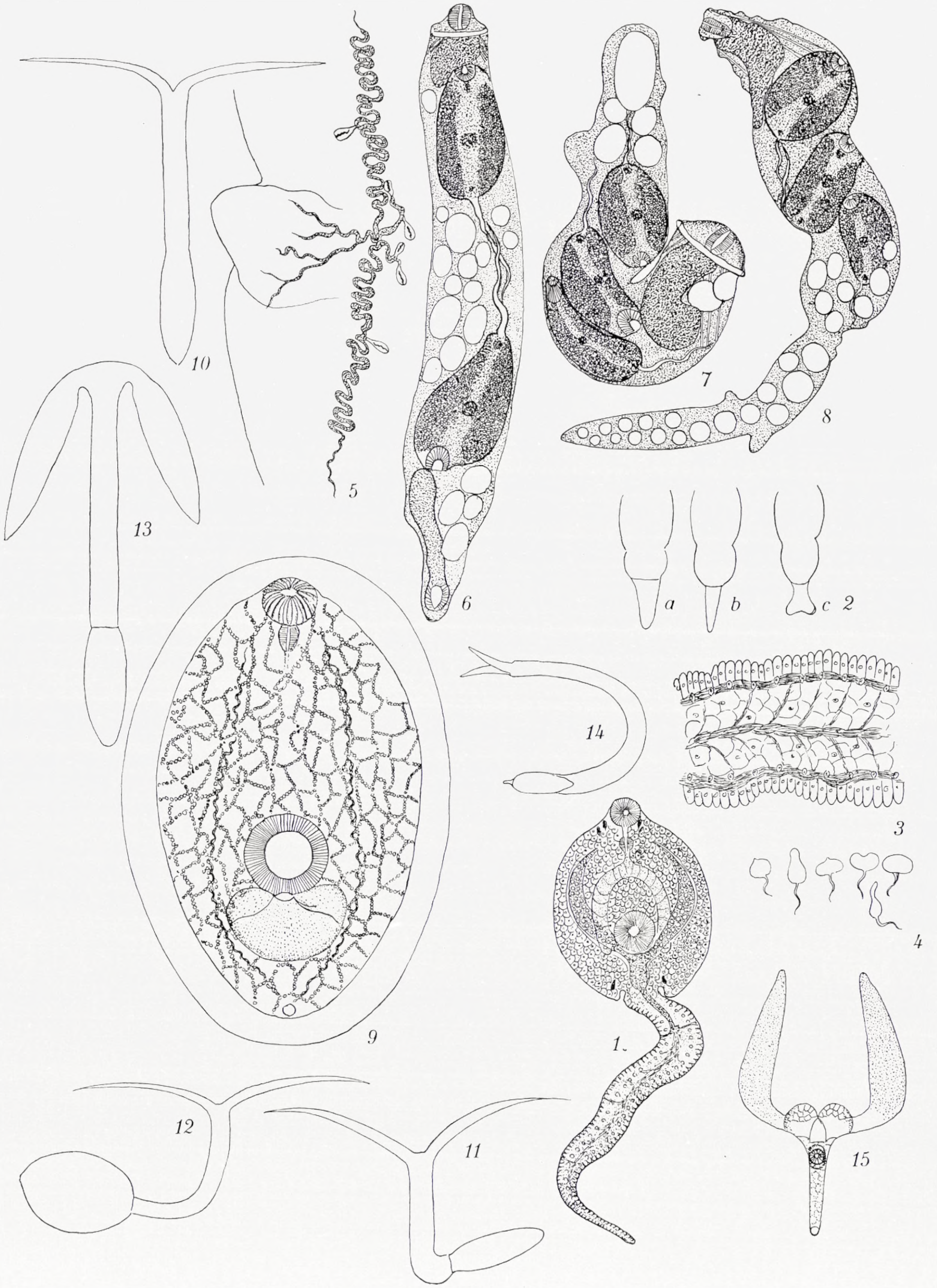
Plate XXXV.

Fig. 1.	*Cercaria Fasciolae hepaticae*	*Limnaea truncatula*	North west part of Sealand	/X 33	Oc. 4	Obj. 16
- 2 a—c.	— The apex of the tail drawn in the course of 5 minutes	—		/X 33	- 4	- 16
- 3.	— part of the tail to show the transversal and lateral musculature	—		/X 33	- 4	- 4
- 4.	— shows the form altering power of the Cercaria	—		/X 33		
- 5.	— Redia. Part of the excretory system	—		/X 33	- 4	- 4
- 6.	— Redia with a daughter redia and two Cercariae	—		/X 33	- 4	- 16
- 7.	— An old Redia	—		/X 33	- 4	- 16
- 8.	— An old Redia	—			- 4	- 16
- 9.	*Cercaria C. Szidat*; cyst found upon the intestine of *Gobio fluviatilis*, the same specimen which contained more than a hundred Diplostomum in the lens	—			- 6	- 16
- 10.	*Cercaria A. Szidat*	Floating positions			- 6	- 16
- 11.	*Cercaria C. Szidat*					
- 12.	*Cercaria vivax*					
- 13.	*Cercaria anchoroides*					
- 14.	*Cercaria cristata*					
- 15.	*Bucephalus polymorphus*					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Microphotos.

Plate XXXVI.

Fig. 1. Monostome Cercaria, *C. ephemera*. Liver from *Planorbis corneus* (Donse Pond 10/XI 31). The photo shows that the Cercariae are lying partly in Rediae partly free in the liver. Haematoxyline. Aurantia. × 70.

- 2. *Furcocercaria C. Szidat*. Liver from *Bithynia tentaculata* (Tjustrup Lake 6/VIII 31). The Furcocercariae lie in Sporocysts. Haematoxyline. Aurantia. × 70.

- 3. *Cercariaeum limnaeae auriculariae* from the border of the mantle at the base of the antennae, here forming large yellow tumor like swellings. From *Limnaea auricularia* Hulsø (20/VI 33). Haematoxyline. Aurantia. × 70.

- 4. The same. The photo shows conspicuously the Sporocyst with the Cercariaea. Haematoxyline. Aurantia. × 70.

- 5. *Bilharziella polonica* from the liver of *Planorbis corneus* (Hørsholm Pond 7/VIII 32). The tissues of the liver are almost totally destroyed. Haematoxyline. Aurantia. × 70.

- 6. *Furcocercaria linearis* n. sp. From the liver of *Planorbis corneus* (Torkeris Pond 4/VII 31). Hardly anything is left of the liver tissues. Thionine, Picrin acid. Acid fuchsine. × 70.

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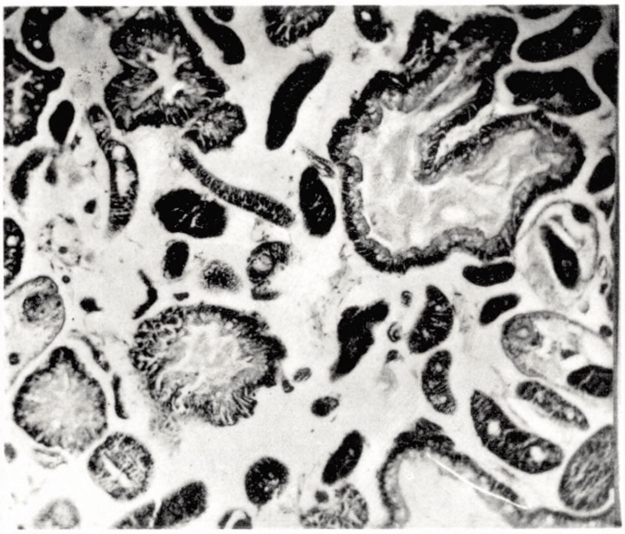

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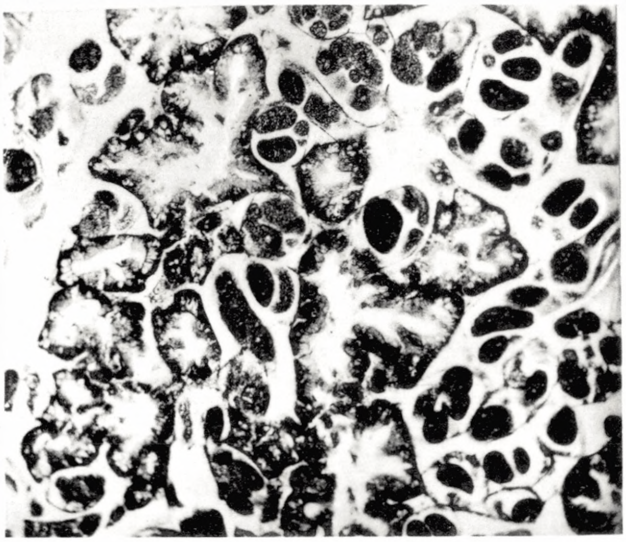

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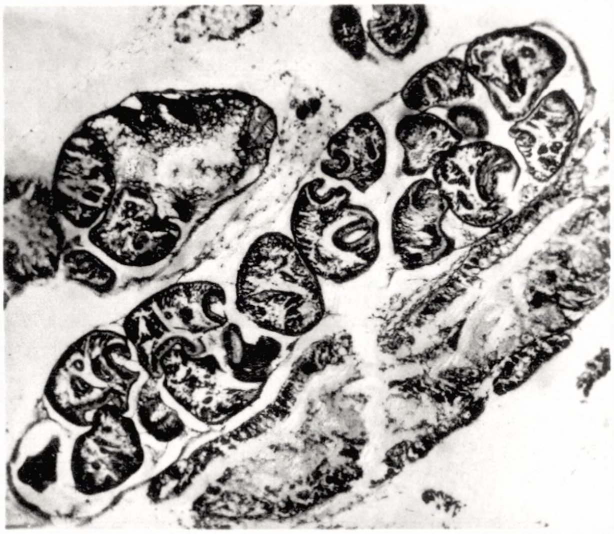

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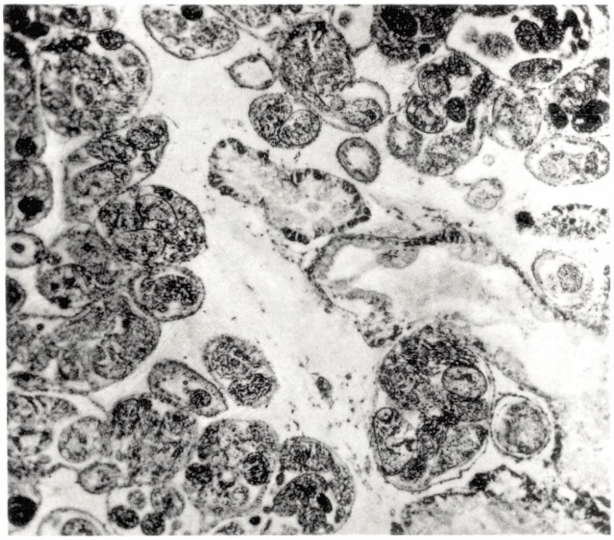

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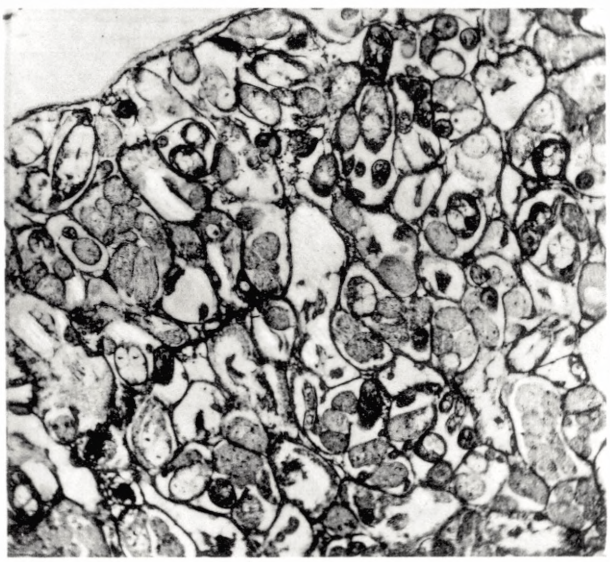


PACHT & CRONE'S EFT., FOTOTYPI

Microphotos.

Plate XXXVII.

Fig. 7. Diplostomum from the lens of *Gobio fluviatilis*. The parasite is photographed in the living state. × 70.

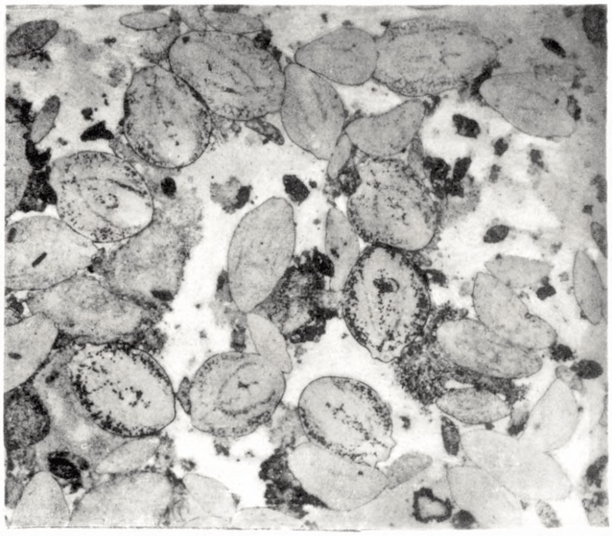
- 8. Cysts upon the intestine of *Gobio fluviatilis*. From the same specimen which had Diplostomum in the lens. × 70.

- 9. Tetracotyle. Sagittal section. (*Limnaea stagnalis* Strødam 22/IV 32). The photo shows the oral and ventral suckers; the holdfast organ and the great secondary excretory canals. Haematoxyline. Aurantia. × 260.

- 10. Tetracotyle from the hermaphroditic gland of *Limnaea stagnalis* (Strødam Pond 11/VII 31). Haematoxyline. Aurantia × 105.

- 11. Tetracotyle (Strødam Pond 11/VII 31). Almost the whole gland is destroyed. The Tetracotyles lie in the acini; at several points are seen eggs along the borders. Haematoxyline. Aurantia. × 105.

- 12. Tetracotyle (Strødam Pond 11/VII 31). The photo shows several well-developed Tetracotyle in the creeping as well as in the resting stage. Near the centre and to the left lie Tetracotyle in the creeping stage. At the lower edge a specimen which has the holdfast organ developed as two long projections. Haematoxyline. Aurantia. × 42.



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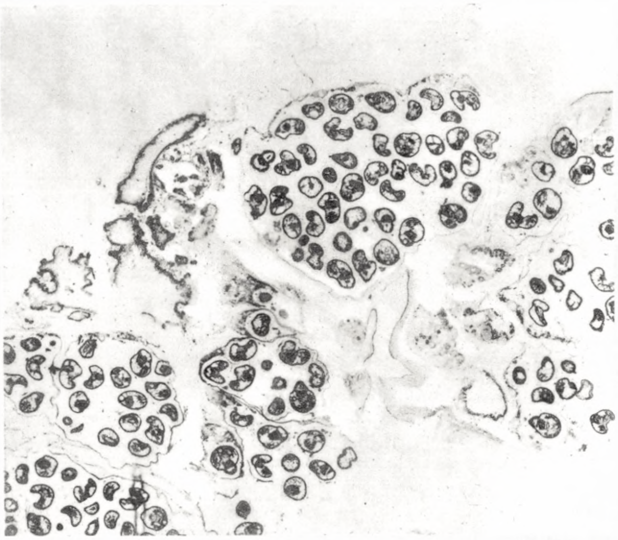

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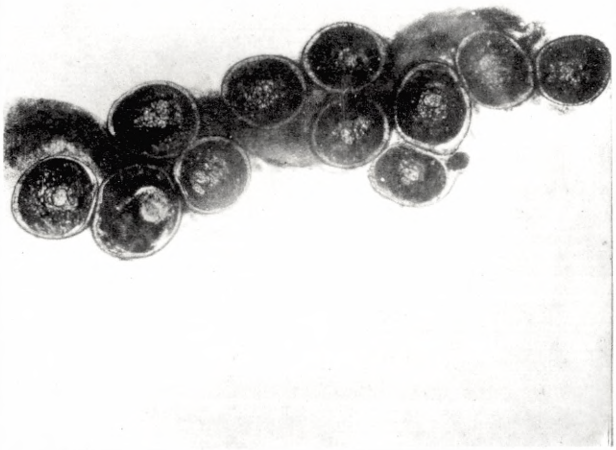

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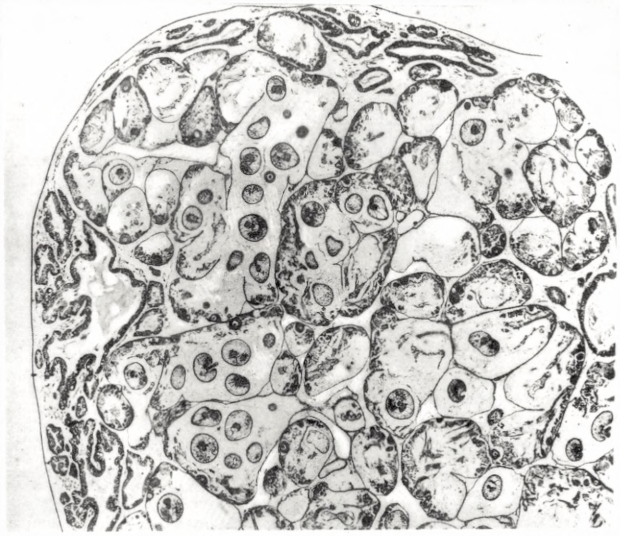

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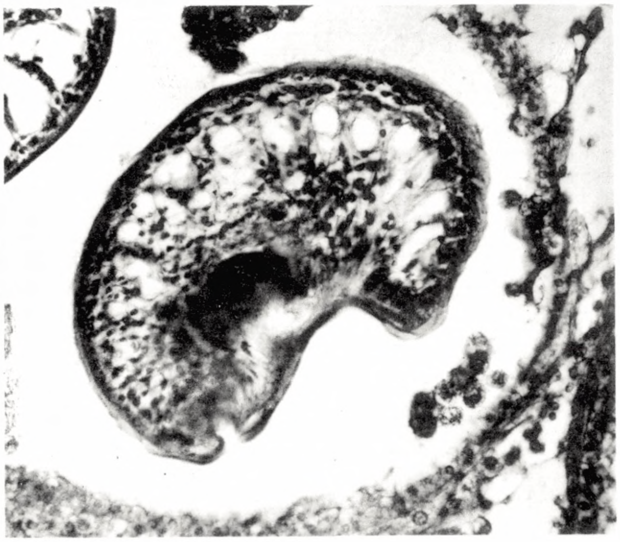

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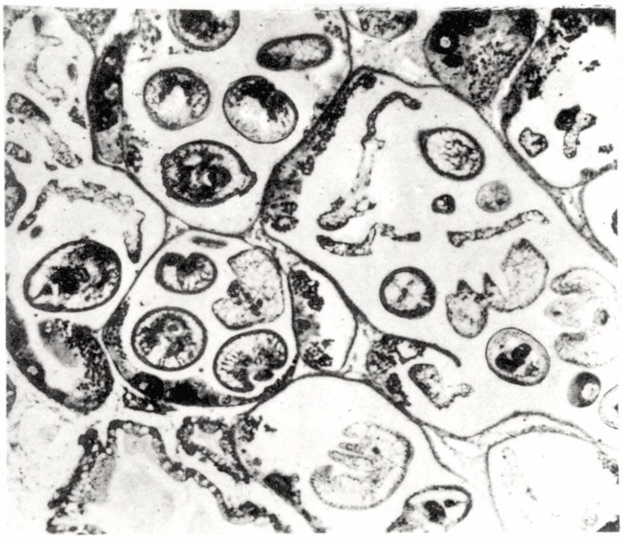

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PACHT & CRONE'S EFT., FOTOTYPI

Microphotos.

Plate XXXVIII.

Fig. 13. *Cercaria virgula* from the liver of *Bithynia tentaculata*. Værebro, Hillerød 17/VII 31. Haematoxyline. Aurantia. × 260.

- 14. Echinostome Redia from *Planorbis corneus*. Torkeris Pond 6/V 31. The Redia is devouring another Redia, having hatched a bit of it which now lies in the oral sucker. Below, another Redia with one of the locomotoric appendages. Haematoxyline. Aurantia. × 70.

- 15. Cysts of echinostome Cercariae in the liver of *Limnaea stagnalis* (Strødam 26/I 32). The bright points in the cysts are the collar spines. Haematoxyline. Aurantia. × 70.

- 16. Cysts of Xiphidiocercariae present in a number of many thousands. The liver is almost totally destroyed. *Bithynia tentaculata*. Hellebæk 30/VII 31. Haematoxyline. Aurantia. × 18.5.

- 17. Echinostome Rediae and Cercariae lying in the liver of *Planorbis corneus*. Torkeris Pond 6/V 31. The tissues are almost entirely destroyed. Haematoxyline. Aurantia. × 70.

- 18. Amphistome Cercariae lying at the borders of the mantle of *Planorbis umbilicatus*. Rejnstrup 15/VIII 32. Thionine, Acid fuchsine. Picrin acid. × 70.

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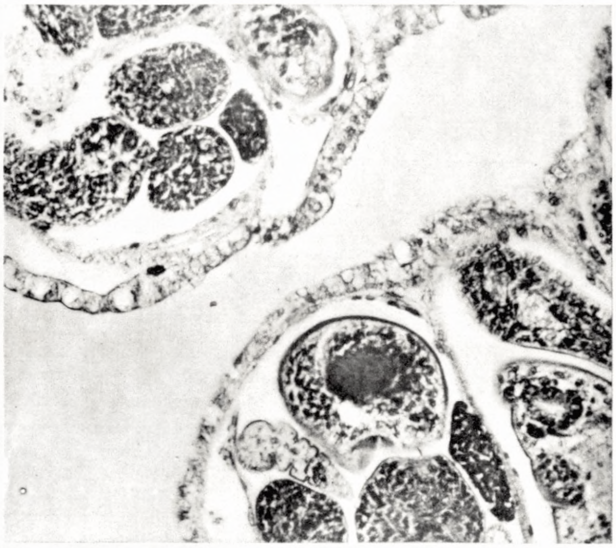

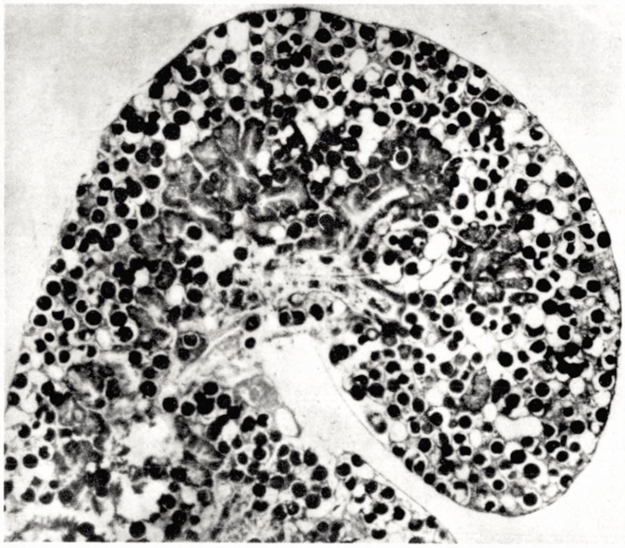
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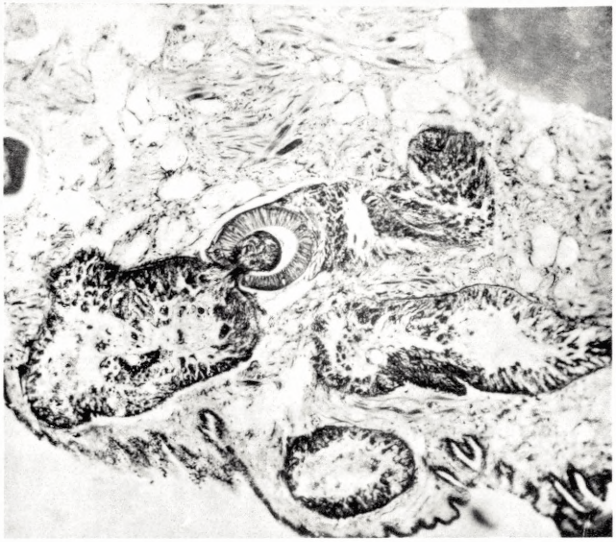

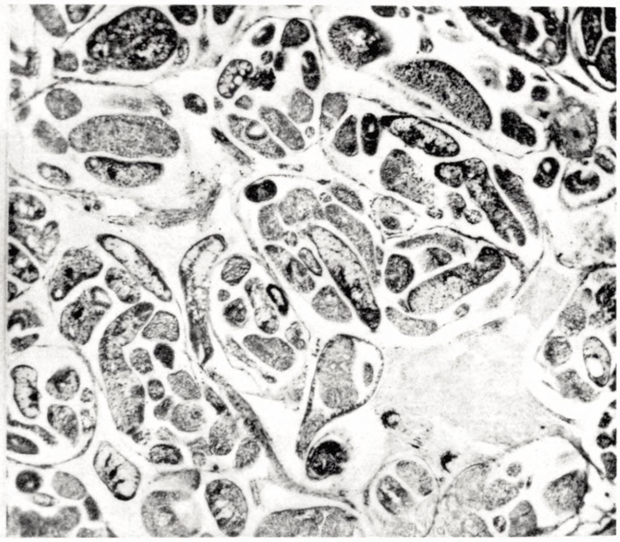
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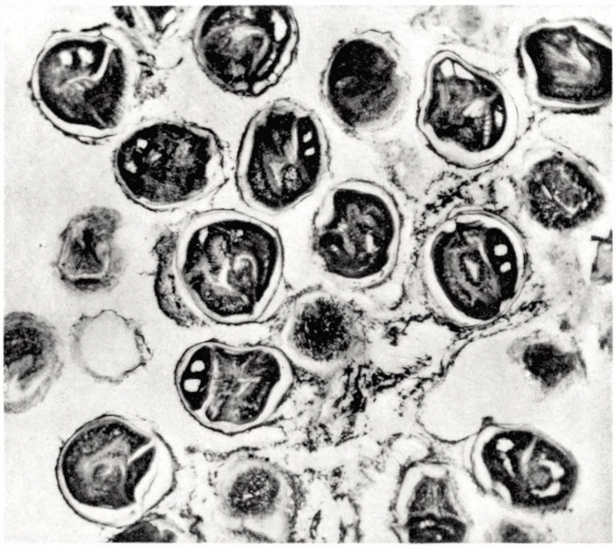

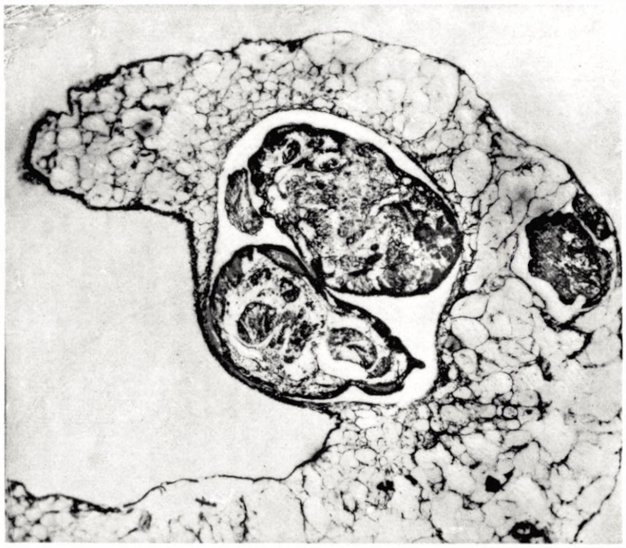
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Pacht & Crone's Eft., Fototypi

Microphotos.

Plate XXXIX.

All photos are taken from living animals.

Fig. 19. *Cercaria vivax* from *Bithynia tentaculata.* Tjustrup Lake 14/V 31. The animals have been disturbed by the strong light. Some of them show the normal position. × 24.

- 20. *Cercaria vivax*; a single individual showing the normal position. × 24.

- 21. *Bilharziella polonica* hanging down from the surface. Hørsholm Pond. × 24.

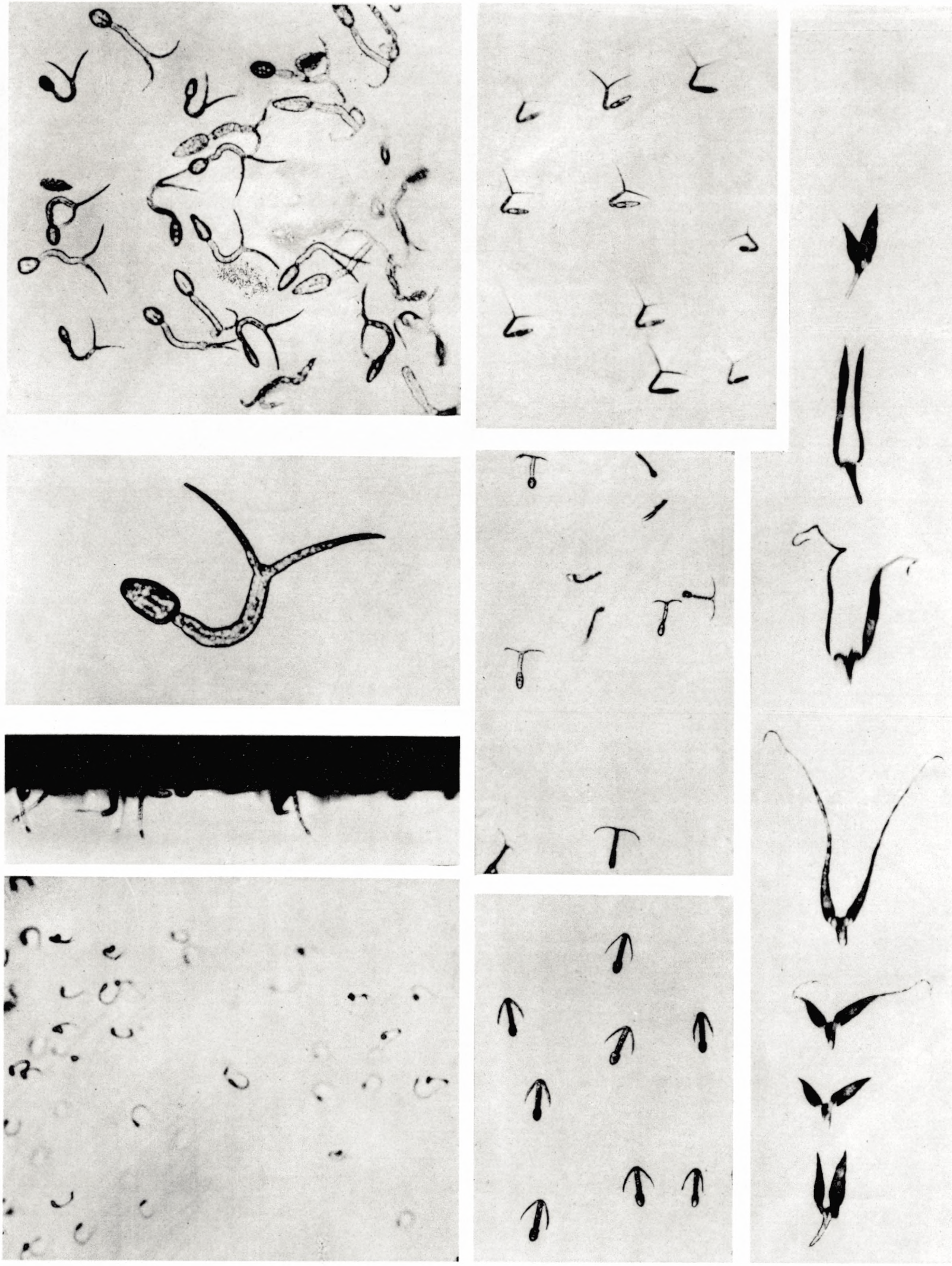
- 22. *Cercaria cristata* from *Limnaea stagnalis.* Langesø 26/VI 31. The larva is able to float in all positions. The typical positions of the Cercariae illustrated on the Microphotos are drawn on Pl. XXXV, figs. 10—15.

- 23 *Cercaria C. Szidat.* The typical floating position with the body held almost parallel with one of the rami.

- 24 *Cercaria helvetica XXXI* Dubois. The typical floating position with the two rami used as outriggers, lying horizontally. × 24.

- 25 *Cercaria 1 Petersen.* The typical floating position, the whole body forming a parachute to prevent the fall. × 31.

- 26. *Bucephalus polymorphus (Anodonta* sp.). A series of photos taken from a dancing larva which, in the fourth figure, has lifted itself up into a higher water layer, and is now using its rami for a moment to anchor itself there. Then, when it withdraws its arms as the three upper photos show, it sinks downwards again to the water layer in which it was originally suspended. × 26.



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Pacht & Crone's Eft., Fototypi

Det Kongelige Danske Videnskabernes Selskab.

Skrifter, naturvidenskabelig og mathematisk Afdeling.

9. Række.

		Kr.	Øre
	I, med 35 Tavler	30.	50.
1.	**Ravn, J. P. J.:** De regulære Echinider i Danmarks Kridtaflejringer. Med 6 Tavler. 1928	7.	00.
2.	**Clausen, Hans:** On the Crystal Structure of Cryolithionite. With 4 Figures in the text. 1928	2.	25.
3.	**Boas, J. V. E.:** Biologisch-anatomische Studien über den Hals der Vögel. Mit 23 Tafeln und 20 Figuren im Text. 1929	20.	00.
4.	**Berg, Kaj** and **Gunnar Nygaard:** Studies on the Plankton in the Lake of Frederiksborg Castle. With 6 Plates and 27 Figures in the text. 1929	11.	50.
	II, med 30 Tavler og 8 Skemaer	23.	25.
1.	**Wesenberg-Lund, C.:** Contributions to the Biology of the Rotifera. Part II. The Periodicity and Sexual Periods. With 15 Plates and 8 Schemata. 1930	20.	00.
2.	**Bøggild, O. B.:** The Shell Structure of the Mollusks. With 15 Plates and 10 Figures in the text. 1930	11.	00.
	III, med 1 Kort og 10 Tavler	23.	20.
1.	**Ostenfeld, C. H.:** The Distribution within Denmark of the higher Plants. Results of the topographic-botanical Investigation. I. A brief Historical Survey of the Investigation. With one Plate. 1931	1.	40.
2.	**Jessen, Knud:** Samme. II. The Distribution of the Papilionaceæ within Denmark. With nine Plates. 1931	7.	00.
3.	**Mølholm Hansen, H.:** Nørholm Hede, en formationsstatistisk Vegetationsmonografi. Med 1 Kort. With English Summary. 1932	10.	00.
4.	**Sørensen, William:** Descriptiones Laniatorum (Arachnidorum Opilionum subordinis). Opus posthumum recognovit et edidit Kai L. Henriksen. With a Preface and Notes in English and 29 Textfigures. 1932	12.	50.
	IV, med 9 Kort og 70 Tavler	41.	75.
1.	**Mortensen, Th.:** Contributions to the Study of the Development and Larval Forms of Echinoderms I—II. With Plates I—VII. 1931	9.	80.
2.	**Brøndsted, H. V.:** Bygningen af Snuden og Ansigtsmuskulaturen hos nogle Pinnipedier med særligt Hensyn til Oppustningssækken hos Klapmydsen. Med 12 Tavler. Mit einem deutschen Résumé. 1931	5.	70.
3.	**Wesenberg-Lund, C.:** Contributions to the Development of the Trematoda Digenea. Part I. The Biology of Leucochloridium Paradoxum. With 6 Plates and 7 Textfigures. 1931	6.	25.
4.	**Mortensen, Th.:** New Contributions to the Knowledge of the Cidarids. I—II. With 13 Plates. 1932	10.	00.
5.	**Nielsen, Niels:** Contributions to the Physiography of Iceland. With particular reference to the Highlands west of Vatnajökull. With 32 Plates and 9 Maps. 1933	10.	00.
	V, med 61 Tavler	42.	75.
1.	**Boas, J. E. V.:** Kreuzbein, Becken und *Plexus lumbosacralis* der Vögel. Mit 15 Tafeln und 33 Figuren im Text. 1933	12.	00.
2.	**Ravn, J. P. J.:** Études sur les Pélécypodes et Gastropodes daniens du Calcaire de Faxe. Avec 7 planches. 1933	7.	75.
3.	**Wesenberg-Lund, C.:** Contributions to the Development of the Trematoda Digenea. Part II. The Biology of the Freshwater Cercariae in Danish Freshwaters. With 35 Plates and 4 Plates of Microphotos. 1934	23.	00.

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